SOIL SURVEY OF

Sherman County, Kansas

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Kansas Agricultural Experiment Station

Issued March 1973

Major fieldwork for this soil survey was done in the period 1958–66. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Sherman County Soil Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SURVEY contains information that can be applied in managing farms, ranches, and windbreaks; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Sherman County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit, either dryland or irrigated, the range site, and the windbreak group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, range sites, and windbreak groups.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Fish and Wildlife Management."

Ranchers and others can find, under "Range Management," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Use of the Soils in Engineering" tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Sherman County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Additional Facts About the County."

Cover picture: **Aerial view of farm near Edson, Kans. The soils are mainly Keith and Ulysses silt loams.**

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SOIL SURVEY OF SHERMAN COUNTY, KANSAS

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SHERMAN COUNTY is in the northwestern part of Kansas (fig. 1). It occupies 675,200 acres, or 1,055 square miles. Goodland, the county seat, has a population of about 5,000. The county population is about 7,000.

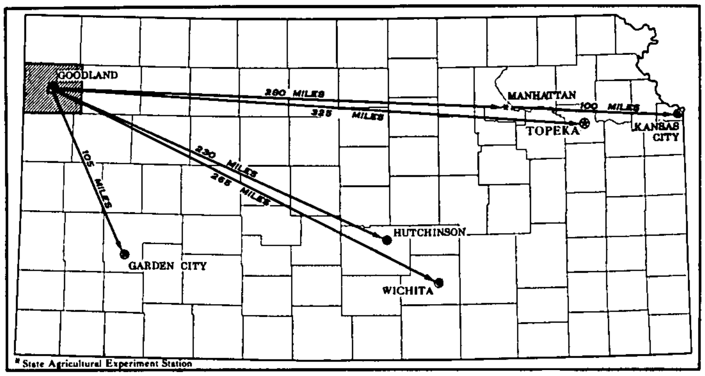

Figure 1.—**Location of Sherman County in Kansas.**

The county has a continental, semiarid climate. It is in the High Plains section of the Great Plains physiographic province. A large part of the county occupies nearly level to gently sloping uplands that have an average slope of about 13 feet in 1 mile. The highest point is about 8 miles south of Kanorado; the elevation is about 4,000 feet. Several points in the southeastern part of the county are at an elevation of about 3,300 feet. The general relief and drainage pattern of the county are shown in figure 2.

Farming and ranching are the main enterprises in the county. Growing wheat, corn, and grain sorghum and raising cattle are the main sources of income. Most of the acreage is cultivated, and much of it is irrigated. Sugar beets are grown on some of the irrigated acreages. There is a sugar beet processing plant at Caruso. The slopes adjacent to drainageways and small areas on the nearly level and gently sloping uplands are still in native grass.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Sherman County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*9*).[1]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Keith and Ulysses, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Ulysses silt loam, 1 to 3 percent slopes, is one of several phases within the Ulysses series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

[1] Italic numbers in parentheses refer to Literature Cited, p. 45.

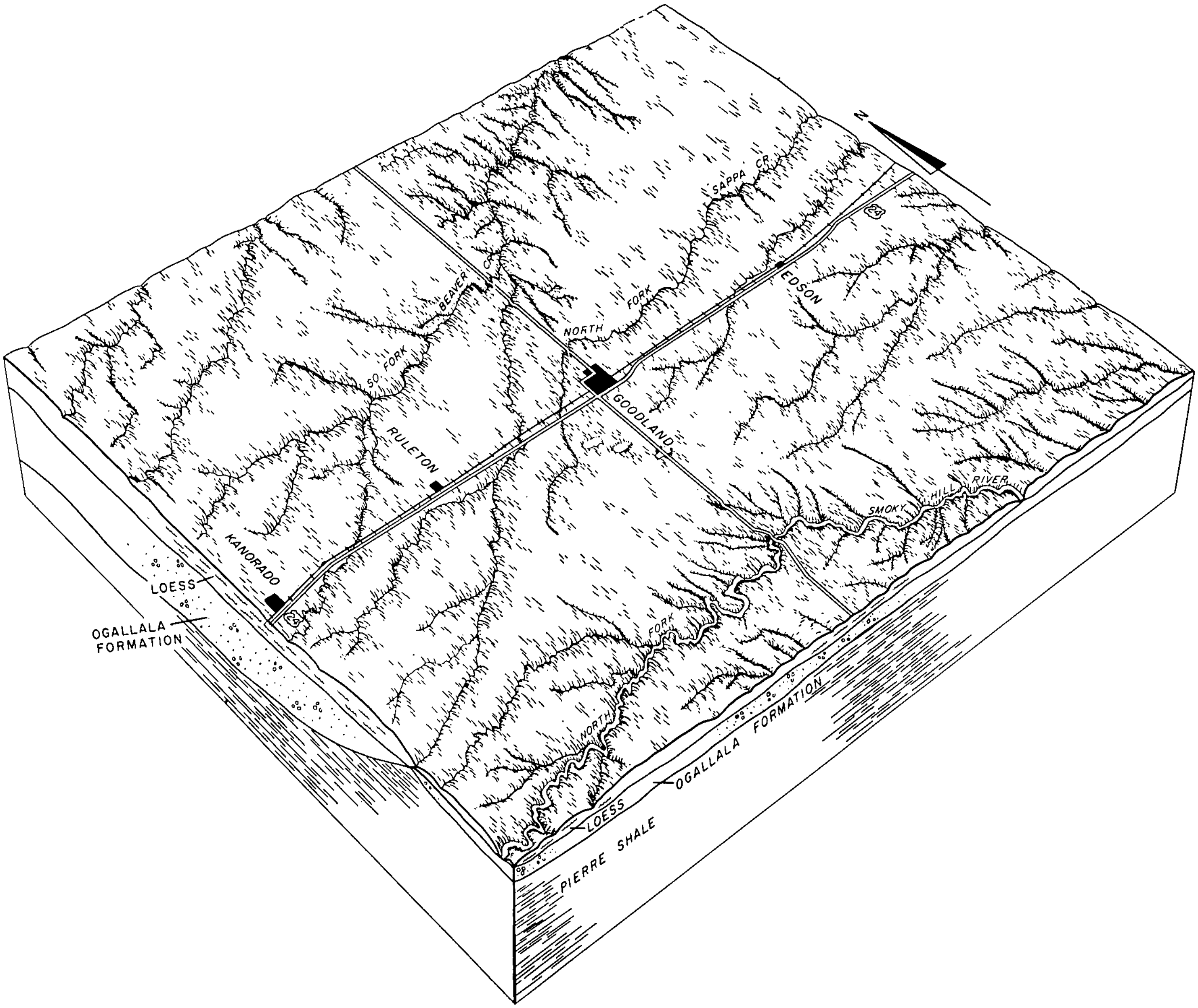

Figure 2.—**Landscape of Sherman County showing relief and drainage.**

Some mapping units are made up of soils of different series, or of different phases within one series. A soil complex is one such kind of mapping unit shown on the soil map of Sherman County.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Keith-Ulysses silt loams, 0 to 1 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rough broken and gravelly land is a land type in Sherman County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the arable soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this publication shows, in color, the soil associations in Sherman County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, range, or a wildlife area, or in locating sites for engineering work and recreational facilities. It is not suitable for planning the management of a farm or field, or for selecting the exact location of a road, building, or structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The three soil associations in Sherman County are described in the following pages. The terms for texture used in the title of an association apply to the surface layer of the major soils in the association. For more detailed information about the individual soils in each association, refer to the detailed map and to the section "Descriptions of the Soils."

1. Keith-Ulysses Association

Deep, well-drained, nearly level and gently sloping silt loams on uplands

This association is on the high plains tableland. Slopes are mainly 0 to 3 percent but range to 6 percent. The soils are well drained but have no well-defined drainage pattern. In places runoff is ponded in small depressions (fig. 3).

This association makes up about 62 percent of the county. It is about 62 percent Keith soils, 35 percent Ulysses soils, and 3 percent minor soils.

Areas of Keith soils are smooth or weakly concave. Slopes are mainly between 0 and 1 percent but range to 3 percent. The surface layer is grayish-brown silt loam about 6 inches thick. The subsoil is about 31 inches thick. It is grayish-brown, firm silty clay loam in the upper part and light brownish-gray, friable silt loam in the lower part. The underlying material is very pale brown silt loam.

Ulysses soils are on low, convex ridges and near drains in smooth or weakly convex areas. Slopes are mainly 1 to 3 percent but range from 0 to 6 percent. The surface layer is grayish-brown silt loam about 11 inches thick. The next layer is light brownish-gray silt loam about 5 inches thick. The underlying material is light-gray silt loam.

Richfield, Goshen, and Pleasant soils are minor in this association. Richfield and Keith soils occupy similar positions. Goshen soils are in swales, and Pleasant soils are in depressions.

Most of this association is cultivated and is well suited to all the dryland and irrigated crops commonly grown in the county. Wheat and sorghum are the main crops. Corn, alfalfa, and sugar beets are grown in irrigated areas. Conserving moisture and controlling erosion are the main problems.

2. Ulysses-Colby-Goshen Association

Deep, well-drained, nearly level to strongly sloping silt loams on uplands, terraces, and flood plains

This association is on side slopes and on bottom land along the more deeply entrenched drainageways and stream valleys in the county. Slopes range from 0 to 15 percent (fig. 4). The major soils are well drained.

This association makes up about 32 percent of the county. It is about 50 percent Ulysses soils, 30 percent Colby soils, 9 percent Goshen soils, and 11 percent minor soils.

Ulysses soils are on side slopes and ridgetops. Slopes are mainly 3 to 10 percent. The surface layer is grayish-brown silt loam about 11 inches thick. Below this is light brownish-gray silt loam about 5 inches thick. The underlying material is light-gray silt loam.

Colby soils are on the steeper side slopes along drainageways. Slopes are mainly 3 to 15 percent. The surface layer is dark grayish-brown silt loam about 4 inches thick. The next layer is pale-brown silt loam 8 inches thick. The underlying material is very pale brown silt loam.

Goshen soils are on terraces and high flood plains. Slopes are mainly 0 to 1 percent. These soils receive extra water from the surrounding uplands, but they are well drained. Their surface layer is about 13 inches thick. It is grayish-brown silt loam in the upper part and dark-gray silt loam in the lower part. The subsoil is about 42 inches thick. It is gray silt loam in the upper part and grayish-brown silty clay loam to light brownish-gray silt loam in the lower part. The underlying material is very pale brown silt loam.

Minor in this association are the Bridgeport, Roxbury, and Caruso soils, Alluvial land, and Wet alluvial land, all of which are on terraces and flood plains, and the Keith soils and Rough broken and gravelly land which are on uplands.

Most of this association is in native range. A small acreage is cultivated. Wheat and sorghum are the main crops on upland. On terraces and flood plains where moisture is favorable, alfalfa is a suitable crop. Controlling erosion and conserving moisture are the main problems.

3. Keith-Ulysses-Goshen Association

Deep, well-drained, nearly level to sloping silt loams on uplands and in swales

This association is on the High Plains tableland. The landscape is gently rolling; long low divides are separated by swales (fig. 5). Slopes are mainly 0 to 3 percent but range to 6 percent. The major soils are well drained. Runoff is ponded in small depressions.

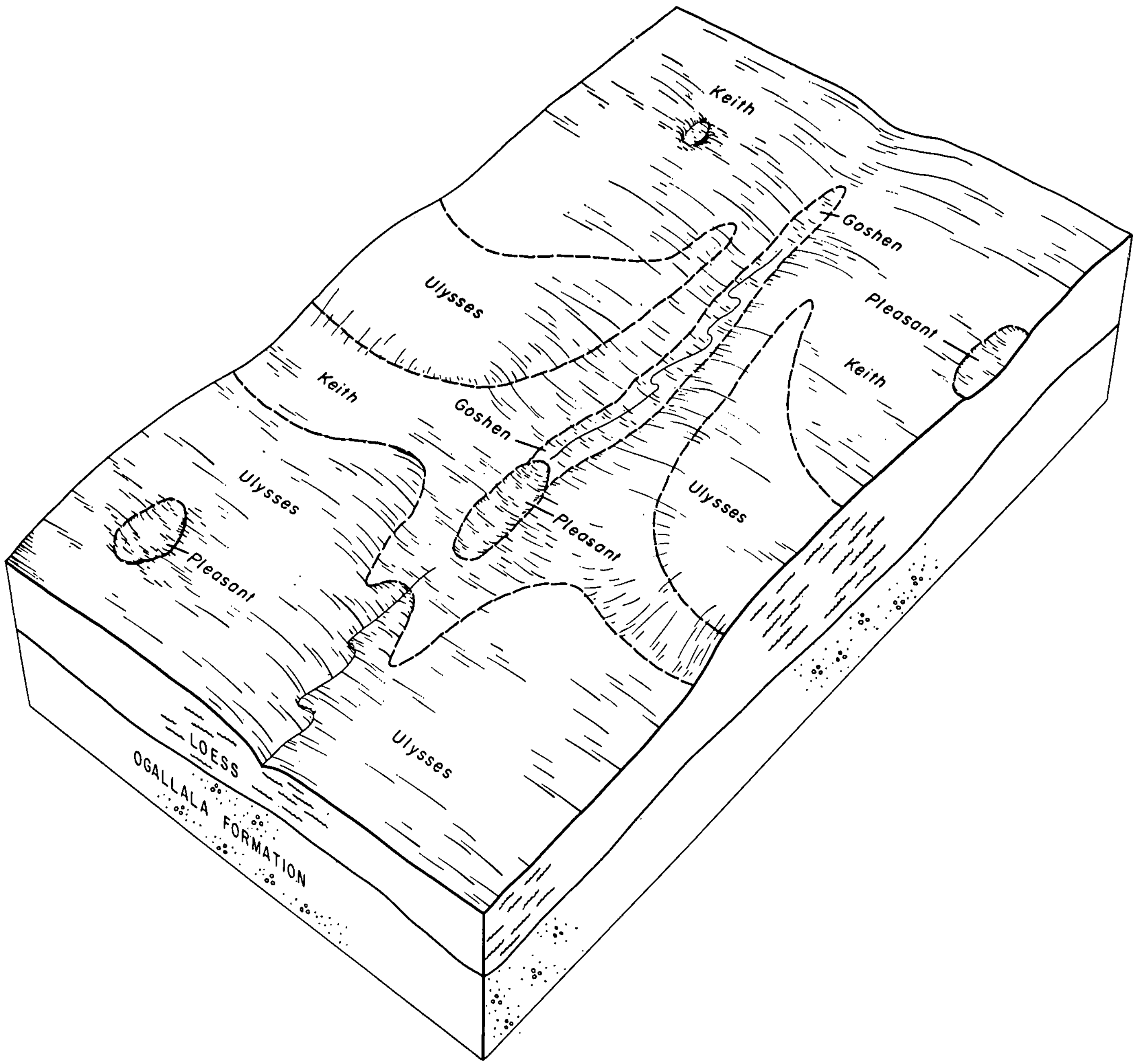

Figure 3.—**Typical pattern of major soils in soil association 1.**

This association makes up about 6 percent of the county. It is about 37 percent Keith soils, 35 percent Ulysses soils, 15 percent Goshen soils, and 13 percent minor soils.

Keith soils occupy smooth or weakly convex areas. Slopes range from 0 to 3 percent. The surface layer is grayish-brown silt loam about 6 inches thick. The subsoil is about 31 inches thick. It is grayish-brown, firm silty clay loam in the upper part and light-brownish gray, friable silt loam in the lower part. The underlying material is very pale brown silt loam.

Ulysses soils are on low ridges and in weakly concave areas. Slopes are mainly between 1 and 3 percent but range from 0 to 6 percent. The surface layer is grayish-brown silt loam about 11 inches thick. Below this is 5 inches of light brownish-gray silt loam. The underlying material is light-gray silt loam.

Goshen soils are in swales. Slopes are 0 to 1 percent. These soils receive runoff from uplands, but they are well drained. Their surface layer is silt loam about 13 inches thick. It is grayish brown in the upper part and ranges to dark gray in the lower part. The subsoil is about 42 inches thick. It is gray silt loam in the upper part and ranges from grayish-brown silty clay loam to light brownish-gray silt loam in the lower part. The underlying material is very pale brown silt loam.

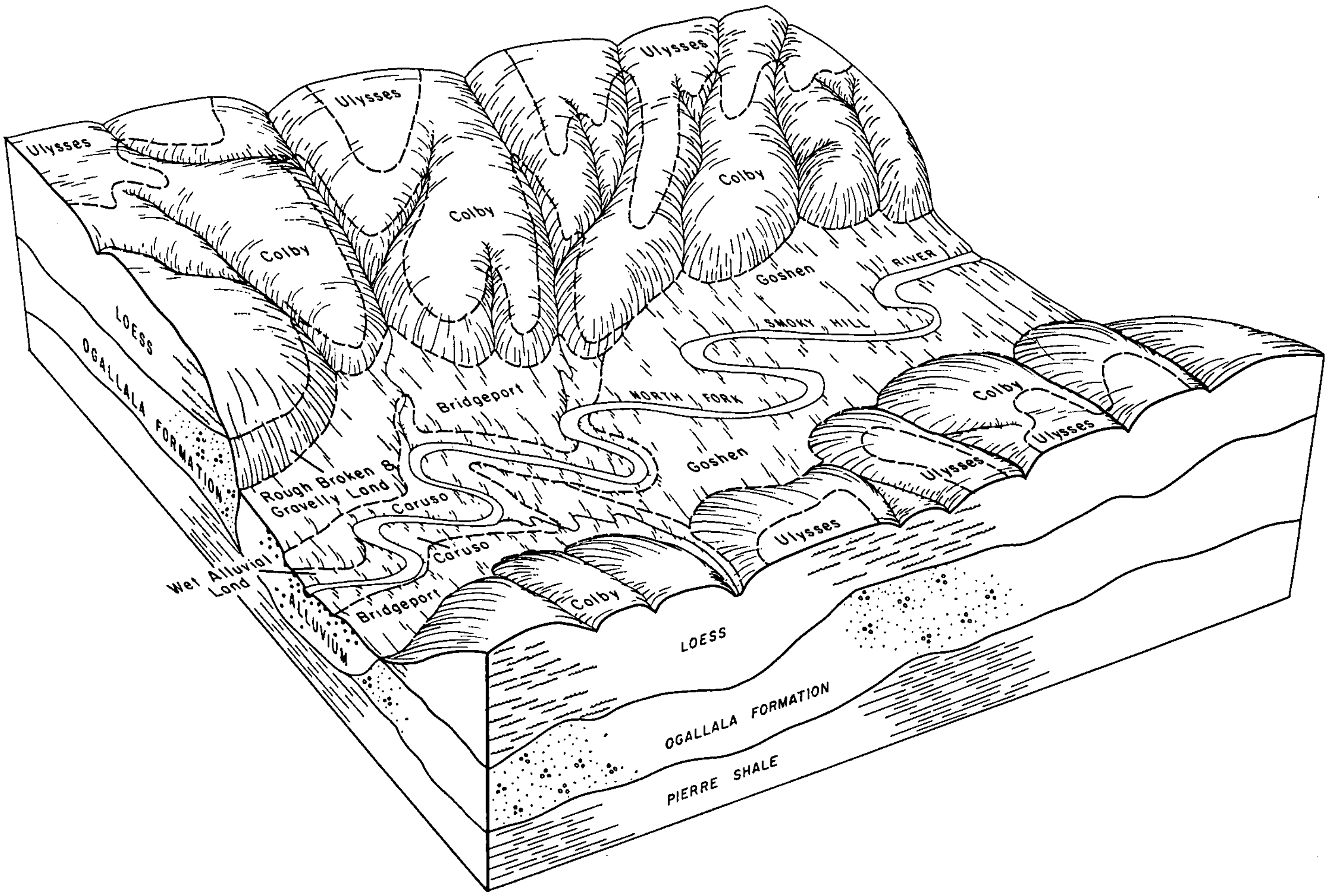

Figure 4.—**Typical pattern of major soils in soil association 2.**

Minor in this association are the Colby and Pleasant soils. Colby soils are on ridgetops and upper parts of slopes. Pleasant soils are in depressions that lack surface drainage.

Most of this association is cultivated and is well suited to all dryland and irrigated crops commonly grown in the county. Wheat and sorghum are the main crops. Corn, alfalfa, and sugar beets are grown in irrigated areas. Conserving moisture and controlling erosion are the main problems.

Descriptions of the Soils

This section describes the soil series and mapping units in Sherman County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a dry soil, and consistence is for a moist soil.

As mentioned in the section "How This Survey Was Made" not all mapping units are members of a soil series. Rough broken and gravelly land, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, and windbreak group in which the mapping unit has been placed. The page for the description of each capability unit and range site can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*9*).

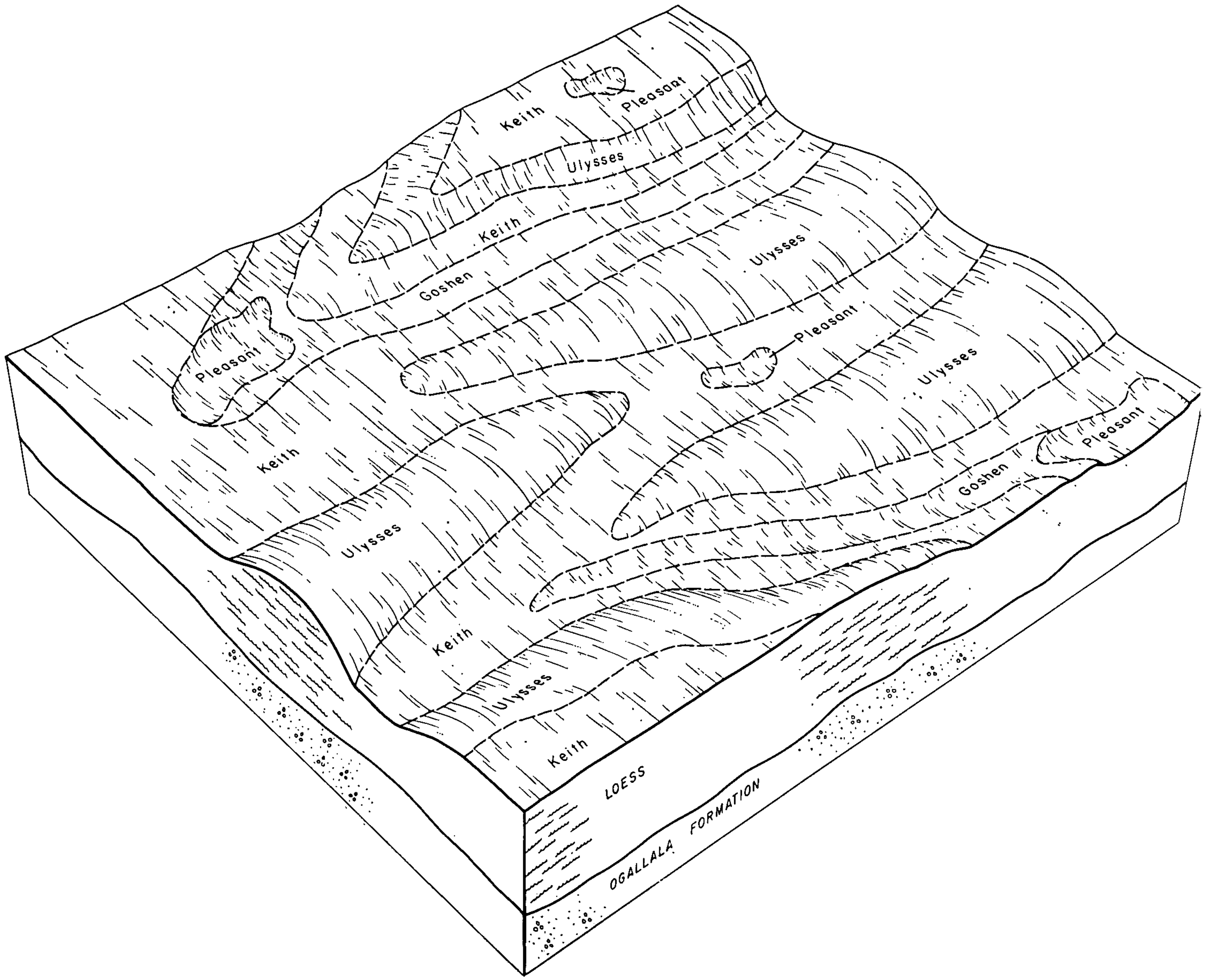

***Figure 5.*—Typical pattern of major soils in soil association 3.**

Alluvial Land

Alluvial land (0 to 2 percent slopes) (Ad) occupies small areas on the narrow alluvial bottoms of upland drainageways. In most places it is bordered by nonarable slopes and is dissected by meandering stream channels. The alluvial bottoms are more than 150 feet wide.

Alluvial land is variable. The soils are calcareous, loamy alluvium. The texture ranges from sandy loam to light silty clay loam. Gravel occurs in places. Sand and gravel are below a depth of 2 feet in some places.

Included in mapping are small areas of sandier soils, the stream channels, and the short, steep side slopes of drainageways. Also included are a few gravelly areas and a few gravel pits, both of which are indicated by spot symbols on the detailed soil map.

Alluvial land is well drained. Runoff is slow, permeability is moderate, and the available water capacity is moderate to high. Flooding is frequent and of short duration. Fertility is high.

Nearly all the acreage is in native grass range to which the soils are well suited. Small areas are used for sorghum or alfalfa. The small size of the areas, the steep side slopes, the meandering stream channels, and frequent flooding make cultivation impractical in most places. Capability unit VIw-1 (dryland), no irrigated unit; Loamy Lowland range site; Lowland windbreak group.

Bridgeport Series

The Bridgeport series consists of deep, well-drained, medium-textured soils on high terraces and alluvial fans along the major streams of the county. These soils formed in deep, medium-textured alluvium. Slopes range from 0 to 4 percent.

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Area	Extent
	Acres	*Percent*
Alluvial land	4, 764	0. 7
Bridgeport silt loam, 0 to 2 percent slopes	3, 313	. 5
Bridgeport silt loam, 2 to 4 percent slopes	2, 688	. 4
Bridgeport-Slickspots complex	360	. 1
Caruso loam	2, 080	. 3
Colby silt loam, 6 to 15 percent slopes	58, 003	8. 6
Colby-Ulysses silt loams, 3 to 6 percent slopes, eroded	12, 371	1. 8
Goshen silt loam	28, 014	4. 1
Keith silt loam, 0 to 1 percent slopes	181, 336	26. 9
Keith silt loam, 1 to 3 percent slopes	52, 101	7. 7
Keith-Ulysses silt loams, 0 to 1 percent slopes	53, 772	8. 0
Pleasant silty clay loam	4, 062	. 6
Richfield silt loam, 0 to 1 percent slopes	7, 210	1. 1
Rough broken and gravelly land	3, 065	. 5
Roxbury silt loam	2, 193	. 3
Roxbury silt loam, frequently flooded	599	. 1
Ulysses silt loam, 1 to 3 percent slopes	127, 804	18. 9
Ulysses silt loam, 3 to 6 percent slopes	58, 398	8. 7
Ulysses silt loam, 6 to 10 percent slopes	37, 181	5. 5
Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded	1, 648	. 2
Ulysses-Keith silt loams, 0 to 1 percent slopes	33, 795	5. 0
Wet alluvial land	171	(1)
State lakes	222	(1)
Gravel pits	50	(1)
Total	675, 200	100. 0

[1] Less than 0.1 percent.

In a representative profile the surface layer is grayish-brown silt loam about 13 inches thick. The next layer is light brownish-gray, friable silt loam about 10 inches thick. The underlying material is light-gray silt loam that extends to a depth of about 60 inches.

Bridgeport soils receive extra water as runoff from the adjacent uplands. Permeability is moderate, and the available water capacity is high. Runoff is slow to moderate, depending on the slope. Fertility is high.

Many areas are in native grass. Wheat and sorghum are the main crops in cultivated areas.

Representative profile of Bridgeport silt loam, 0 to 2 percent slopes, in native range, 3,600 feet west and 375 feet north of the southeast corner of section 25, T. 10 S., R. 39 W.:

A1—0 to 13 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, fine, granular; slightly hard when dry, friable when moist; many roots; mixed weakly calcareous and noncalcareous; moderately alkaline; gradual, smooth boundary.

AC—13 to 23 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; strongly calcareous; moderately alkaline; gradual, smooth boundary.

C—23 to 60 inches, light-gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; silghtly hard when dry, friable when moist; few roots to a depth of 36 inches; strongly calcareous; moderately alkaline.

The A1 horizon ranges from 6 to 15 inches in thickness and from grayish brown to dark grayish brown in color. Its texture is dominantly silt loam but ranges to loam or light silty clay loam. The AC horizon ranges from 8 to 15 inches in thickness and from light brownish gray to pale brown in color. Its texture ranges from loam to silty clay loam but is dominantly silt loam. In some places the profile is uniform in texture, but in many places it is stratified in both texture and color. The A1 horizon is mildly alkaline or moderately alkaline, and the AC and C horizons are moderately alkaline. Depth to calcareous material ranges from the surface down to 10 inches. In some places sand and gravel are below a depth of 40 inches.

Bridgeport soils are in positions similar to those of Caruso, Goshen, and Roxbury soils. They are calcareous at a shallower depth than Goshen soils and lack the B2t horizon of those soils. They lack the fluctuating water table and the mottling that are characteristic of Caruso soils. Their dark color extends to a lesser depth than in Roxbury soils.

Bridgeport silt loam, 0 to 2 percent slopes (Bd).—This soil occupies small areas on terraces and alluvial fans slightly above the flood plain of the larger streams in the county. It receives extra water as runoff from the adjacent uplands. In most places slopes are less than 1 percent. This soil has the profile described as representative for the series.

Included in mapping are small areas of Goshen silt loam and a few gravelly areas, indicated on the detailed soil map by the gravel spot symbol.

Soil blowing is a hazard in areas that are not protected by a vegetative cover. Some areas need protection from runoff water from the adjacent uplands.

About half the acreage is cultivated. This soil is well suited to wheat, sorghum, and native grass range. Capability unit IIc-2 (dryland), unit I-2 (irrigated); Loamy Terrace range site; Upland windbreak group.

Bridgeport silt loam, 2 to 4 percent slopes (Be).—This soil occupies small areas on alluvial fans, terraces, and colluvial-alluvial foot slopes in the valleys of the larger streams of the county. It receives extra water as runoff from the adjacent uplands. In many places this soil has a scoured appearance. The runoff from adjacent uplands has eroded the soil and left many low divides that are dissected by shallow drainageways. The profile of this soil is similar to the one described as representative for the series, except that its surface layer is about 8 inches thick.

Included in mapping are small areas of sandier soils that are below sandy outcrops in the adjacent uplands.

Controlling soil blowing and water erosion and conserving moisture are problems.

About half the acreage is cultivated. This soil is suited to native grass range, wheat, and sorghum. Capability unit IIIe-1 (dryland), unit IIe-1 (irrigated); Loamy Terrace range site; Upland windbreak group.

Bridgeport-Slickspots complex (0 to 2 percent slopes) (Bs).—This mapping unit occupies small areas on terraces and alluvial fans slightly above the flood plain of the North Fork of the Smoky Hill River. It is characterized by many small, depressed, generally barren areas, or Slickspots, that hold water after a rain (fig. 6). The soils are in positions similar to and in association with Bridgeport silt loam, 0 to 2 percent slopes. They receive extra water as runoff from the adjacent uplands. This mapping unit is about 25 percent Bridgeport soils, 20 percent Slickspots, and 55 percent moderately dispersed soils.

The Bridgeport soil has the profile described as representative for the series. Slickspots have a surface layer of grayish-brown silt loam about 4 inches thick. The next

Figure 6.—**Typical area of Bridgeport-Slickspots complex.**

layer is about 14 inches thick. The upper 5 inches is gray, firm light silty clay, and the lower 9 inches is dark grayish-brown, firm silty clay loam. The underlying material, to a depth of about 60 inches, is light brownish-gray silty clay loam. The moderately dispersed soils have characteristics that are intermediate to the Bridgeport soils and the Slickspots.

These soils have low to high fertility and high available water capacity. Permeability is moderate on the Bridgeport soil and is very slow on the Slickspots. The soils are well drained to somewhat poorly drained.

Most of the acreage is in native grass range to which the soils are suited. A small acreage adjoining other Bridgeport soils is cultivated. Growth of cultivated crops is seriously restricted, particularly in the Slickspots areas. Many of the scattered, depressed areas are barren. Capability unit IVs–1 (dryland), unit IVs–1 (irrigated); Loamy Terrace range site; no windbreak group.

Caruso Series

The Caruso series consists of deep, calcareous, medium-textured soils that are moderately well drained to somewhat poorly drained. These soils are on flood plains of the North Fork of the Smoky Hill River and Beaver Creek. They formed in somewhat stratified alluvium. Slopes range from 0 to 1 percent.

In a representative profile the surface layer is about 18 inches thick. The upper 4 inches is gray loam, and the lower 14 inches is grayish-brown loam. The next layer, about 15 inches thick, is light brownish-gray, friable loam that has a few, fine, faint, brown mottles. The underlying material is stratified in color and texture and has a few, fine, faint, brownish mottles in the upper part. It is mainly grayish-brown or light brownish-gray loam with a few thin strata of sandy loam. Below a depth of 44 inches are common, faint, fine, yellowish-brown mottles.

Caruso soils have moderate permeability and high available water capacity. Runoff is slow. The water table

is usually at a depth of 4 to 8 feet but rises to within 2 feet of the surface during wet periods. These soils are subject to occasional flooding. They are slightly to moderately saline. Fertility is medium.

These soils are used for cultivated crops and native grass range. Alfalfa and sorghum are the main crops in cultivated areas. In some places the native grass is cut for hay.

Representative profile of Caruso loam in native grass range, 140 feet east and 1,584 feet north of the southwest corner of section 8, T. 10 S., R. 39 W.:

A11—0 to 4 inches, gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; many fine roots; calcareous; moderate soluble salt content; moderately alkaline; clear, smooth boundary.

A12—4 to 18 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; numerous worm casts; many fine roots; calcareous; slight soluble salt content; moderately alkaline; gradual, smooth boundary.

C1—18 to 33 inches, light brownish-gray (10YR 6/2) loam (approaching sandy loam), dark grayish brown (10YR 4/2) when moist; few, fine, faint, brown mottles; weak, fine, granular structure; slightly hard when dry, friable when moist; few fine roots; calcareous; moderately alkaline; gradual, smooth boundary.

C2—33 to 44 inches, grayish-brown (10YR 5/2) heavy loam, very dark grayish brown (10YR 3/2) when moist; contains thin strata that have colors like the C1 horizon; few, fine, faint, brownish mottles; massive; porous; hard when dry, friable when moist; few fine roots; calcareous; moderately alkaline; gradual, smooth boundary.

C3—44 to 60 inches, light brownish-gray (10YR 6/2) loam, few thin strata of sandy loam, grayish brown (10YR 5/2) when moist; common, faint, fine, yellowish-brown mottles; massive; hard when dry, friable when moist; few fine roots; calcareous; moderately alkaline; saturated with water when sampled.

The A horizon ranges from 7 to 28 inches in thickness and from gray to dark grayish brown in color. The texture ranges from loam to clay loam but is dominantly loam. The C horizon ranges from loam to clay loam and in places is stratified with sandier material. These layers typically are more than 15 percent sand coarser than very fine sand. Faint to distinct mottles are within 30 inches of the surface. In many places sand and gravel are at a depth between 40 and 60 inches.

Caruso soils occur in positions similar to those of Bridgeport, Goshen, and Roxbury soils. In contrast with those soils, they are mottled and have a fluctuating water table. They lack the B2t horizon typical of Goshen soils.

Caruso loam (0 to 1 percent slopes) (Ca).—This soil is on the flood plain of the North Fork of the Smoky Hill River and Beaver Creek.

Included in mapping are small areas of Bridgeport silt loam and Wet alluvial land, and areas consisting of the steep sides and narrow channels of streams.

The fluctuating water table, the salinity, occasional flooding, and soil blowing are hazards.

Most of the acreage is used for native grass range. A few areas are cultivated. This soil is suited to alfalfa and sorghum and is well suited to native grass range. Capability unit IIIw-1 (dryland), unit IIw-1 (irrigated); Saline Subirrigated range site; Lowland windbreak group.

Colby Series

The Colby series consists of deep, well-drained, medium-textured, calcareous soils. These soils are on side slopes along the larger drainageways in the county. They formed in deep, medium-textured loess. Slopes range from 1 to 15 percent (fig. 7).

In a representative profile the surface layer is dark grayish-brown silt loam about 4 inches thick. The next layer is pale-brown, friable silt loam about 8 inches thick. The underlying material is very pale brown silt loam and contains visible lime.

Permeability is moderate, and the available water capacity is high. Runoff is moderate to rapid, depending on the slope. Fertility is medium.

Most of the acreage is in native grass range. Wheat and sorghum are the main crops in cultivated areas. The native vegetation is mainly short and mid grasses.

Representative profile of Colby silt loam, 6 to 15 percent slopes, in native grass range, 1,980 feet east and 160 feet south of the northwest corner of section 18, T. 10 S., R. 39 W:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure breaking to weak, very fine, granular; slightly hard when dry, friable when moist; many roots; noncalcareous; mildly alkaline; gradual, smooth boundary.

AC—4 to 12 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; few fine roots; many worm casts; some mixing of color with that of horizon above; calcareous; moderately alkaline; gradual, smooth boundary.

C—12 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure, or massive; soft when dry, very friable when moist; porous; calcareous; few fine streaks or threads of free lime; moderately alkaline.

The A1 horizon ranges from 4 to 6 inches in thickness and from very fine sandy loam to light silty clay loam in texture; the dominant texture is silt loam. The mixed color of the top 7 inches has a value of 5.5 or more when dry and 3.5 or more when moist, but in most grassy areas the top few inches is darker colored. The AC horizon ranges from 3 to 10 inches in thickness and from light brownish gray to very pale brown in color.

Colby soils are associated with Keith, Richfield, and Ulysses soils. They are calcareous nearer the surface than Keith and Richfield soils and lack the B2t horizon typical of those soils. The top 7 inches of Colby soils is lighter colored than that of Ulysses soils.

Colby silt loam, 6 to 15 percent slopes (Cb).—This soil occupies side slopes of the more deeply entrenched drainageways in the county. It has the profile described as representative for the series.

Included in mapping are small areas of loamy soils on the narrow valley floors, small areas of sandy or gravelly soils that are shallow to deep over hard caliche, and small areas of clayey soils that are shallow over shale. Caliche outcrops and a few outcrops of noncalcareous clayey shale are indicated on the soil map by the rock outcrop symbol; gravel outcrops, by the gravel spot symbol; and gravel pits, by the gravel pit symbol.

Surface runoff is rapid. Water erosion and soil blowing are severe hazards unless a good vegetative cover is maintained.

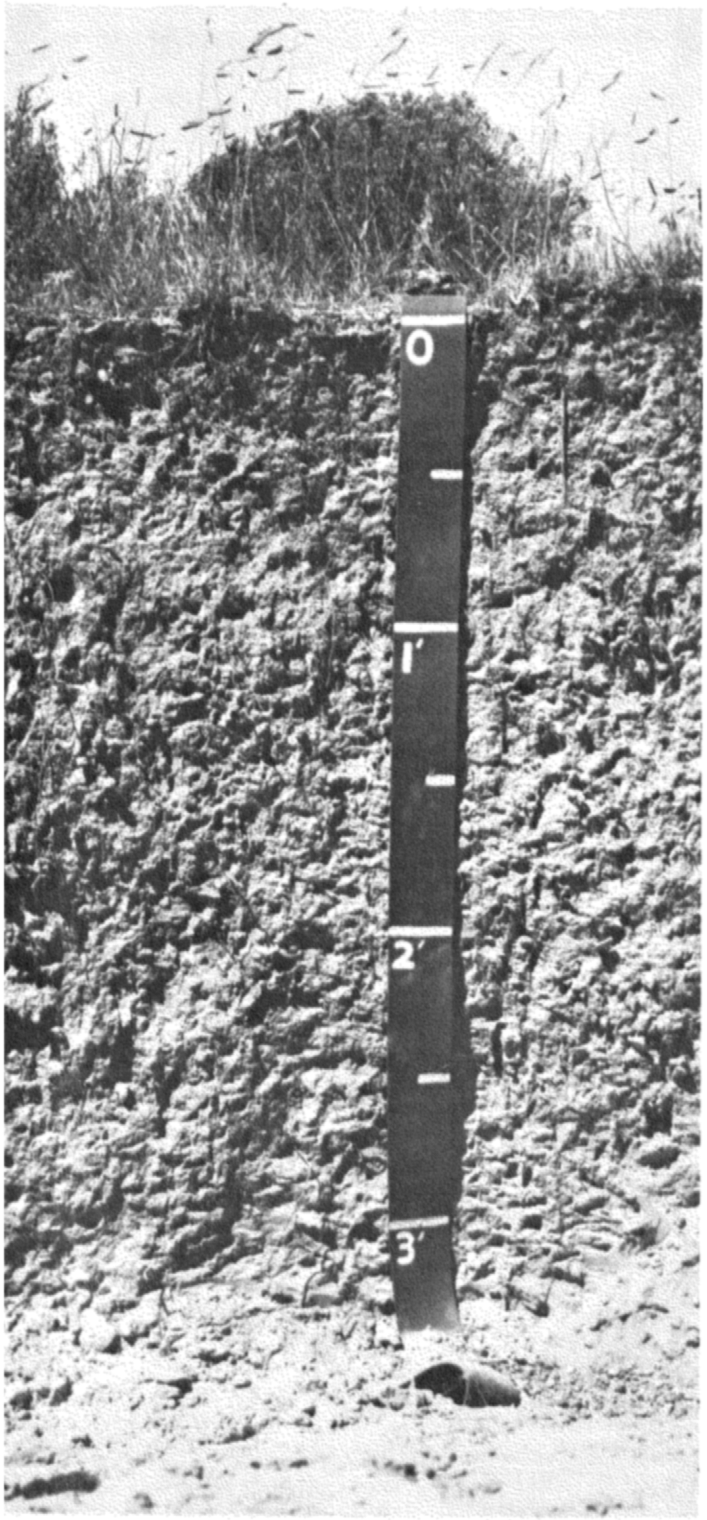

Figure 7.—**Profile of a Colby silt loam.**

This soil is used mainly for native grass range. Only a few areas are cultivated. The soil is well suited to native grass. Capability unit VIe–1 (dryland), no irrigated unit; Limy Upland range site; Upland windbreak group.

Colby-Ulysses silt loams, 3 to 6 percent slopes, eroded (Cu).—This mapping unit occupies the side slopes of U-shaped drainageways. It is about 60 percent Colby silt loam and 40 percent Ulysses silt loam. The Colby soil has a profile similar to the one described as representative for the Colby series but has been formed by erosion of the Ulysses soil. Much of the Colby soil is so eroded that it shows only minimum development. The profile of the Ulysses soil is similar to the one described as representative for the Ulysses series, but it also has been thinned by erosion.

Included in mapping, in narrow bottoms of U-shaped drainageways, are small areas of loamy soils.

Runoff is moderate. Water erosion and soil blowing are severe hazards unless a good vegetative cover is maintained.

Most of the acreage is under cultivation. A few areas are in native grass range or have been reseeded to native grass. The soils are suited to native grass range, wheat, and sorghum. Capability unit IVe–1 (dryland), unit IIIe–1 (irrigated); Limy Upland range site; Upland windbreak group.

Goshen Series

The Goshen series consists of deep, well-drained, medium-textured soils. These soils are on terraces and high flood plains along the larger streams and in swales and small concave areas on uplands. They formed in deep, medium-textured, alluvial-colluvial sediments eroded from the nearby uplands. Slopes are less than 1 percent.

In a representative profile the surface layer is grayish-brown silt loam in the upper 5 inches and dark-gray silt loam in the lower 8 inches. The subsoil is about 42 inches thick. In sequence from the top, the upper 9 inches is gray, friable silt loam; the next 12 inches is grayish-brown, friable silty clay loam; the third layer is 6 inches of light brownish-gray, friable silty clay loam; and the lower 15 inches is light brownish-gray, friable silt loam. The underlying material is very pale brown silt loam (fig. 8).

Goshen soils receive extra moisture as runoff from adjacent soils and are occasionally flooded for short periods. Permeability is moderate, and the available water capacity is high. Runoff is slow. Fertility is high.

These soils are used for cultivated crops and native grass range. Wheat and sorghum are the most common crops. Alfalfa is grown in a few places. Corn, alfalfa, and sugar beets are grown in many irrigated areas.

Representative profile of Goshen silt loam in a cultivated field, 180 feet north and 2,550 feet east of the southwest corner of section 27, T. 7 S., R. 39 W.:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, very fine granular structure; slightly hard when dry, friable when moist; noncalcareous; neutral; gradual, smooth boundary.

A1—5 to 13 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; numerous worm casts; noncalcareous; neutral; gradual, smooth boundary.

B1—13 to 22 inches, gray (10YR 5/1) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; numerous worm casts; noncalcareous; neutral; gradual, smooth boundary.

B21t—22 to 34 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; neutral; gradual, smooth boundary.

B22t—34 to 40 inches, light brownish-gray (10YR 6/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—40 to 55 inches, light brownish-gray (10YR 6/2) heavy silt loam, dark grayish brown (10YR 4/2) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; films and threads of soft lime; moderately alkaline; gradual, smooth boundary.

C—55 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; porous; soft when dry, very friable when moist; calcareous; few fine threads of free lime; moderately alkaline.

The Ap and A1 horizons combined range from 10 to 20 inches in thickness and from grayish brown to dark gray in color. The texture is dominantly silt loam but ranges to loam or light silty clay loam. The B1 horizon is 5 to 10 inches thick and ranges from gray to dark grayish brown in color. The B2t horizon is 14 to 22 inches thick. It ranges from gray to dark grayish brown in the upper part and from gray to light brownish gray in the lower part. Depth to calcareous material averages 30 inches but ranges from 20 to 40 inches.

Goshen soils are associated with Bridgeport, Roxbury, and Ulysses soils. They are noncalcareous to a greater depth than those soils, and they have a B2t horizon which those soils lack. They are dark colored to a greater depth than Keith soils. They have a less clayey B2t horizon than Pleasant and Richfield soils. Their B2t horizon and the lack of mottling distinguish Goshen soils from Caruso soils.

Goshen silt loam (0 to 1 percent slopes) (Go).—This soil is on terraces and high flood plains along the larger streams and in swales and small concave areas on uplands. It receives extra water as runoff from the uplands and is occasionally flooded for short periods.

Included in mapping are a few small areas of Pleasant soils and gravelly soils. Inclusions of Pleasant soils are indicated on the soil map by the depression spot symbol and the gravelly areas by the gravel spot symbol.

This soil is used for cultivated crops and native grass range. It is well suited to all the commonly grown dryland and irrigated crops and also to native grass range. Capability unit IIc-2 (dryland), unit I-2 (irrigated); Loamy Terrace range site; Lowland windbreak group.

Keith Series

The Keith series consists of deep, well-drained, medium-textured soils on uplands. These soils formed in deep, silty, calcareous loess (fig. 9). Slopes range from 0 to 3 percent.

In a representative profile the surface layer is grayish-brown silt loam about 6 inches thick. The subsoil is about 31 inches thick. In sequence from the top, the upper 8 inches is grayish-brown, firm silty clay loam; the next layer is 6 inches of dark grayish-brown, friable heavy silt loam; and the lower 17 inches is light brownish-gray, friable silt loam. The underlying material is very pale brown silt loam.

Keith soils have moderate permeability and high available water capacity. Runoff is slow to medium. Fertility is high.

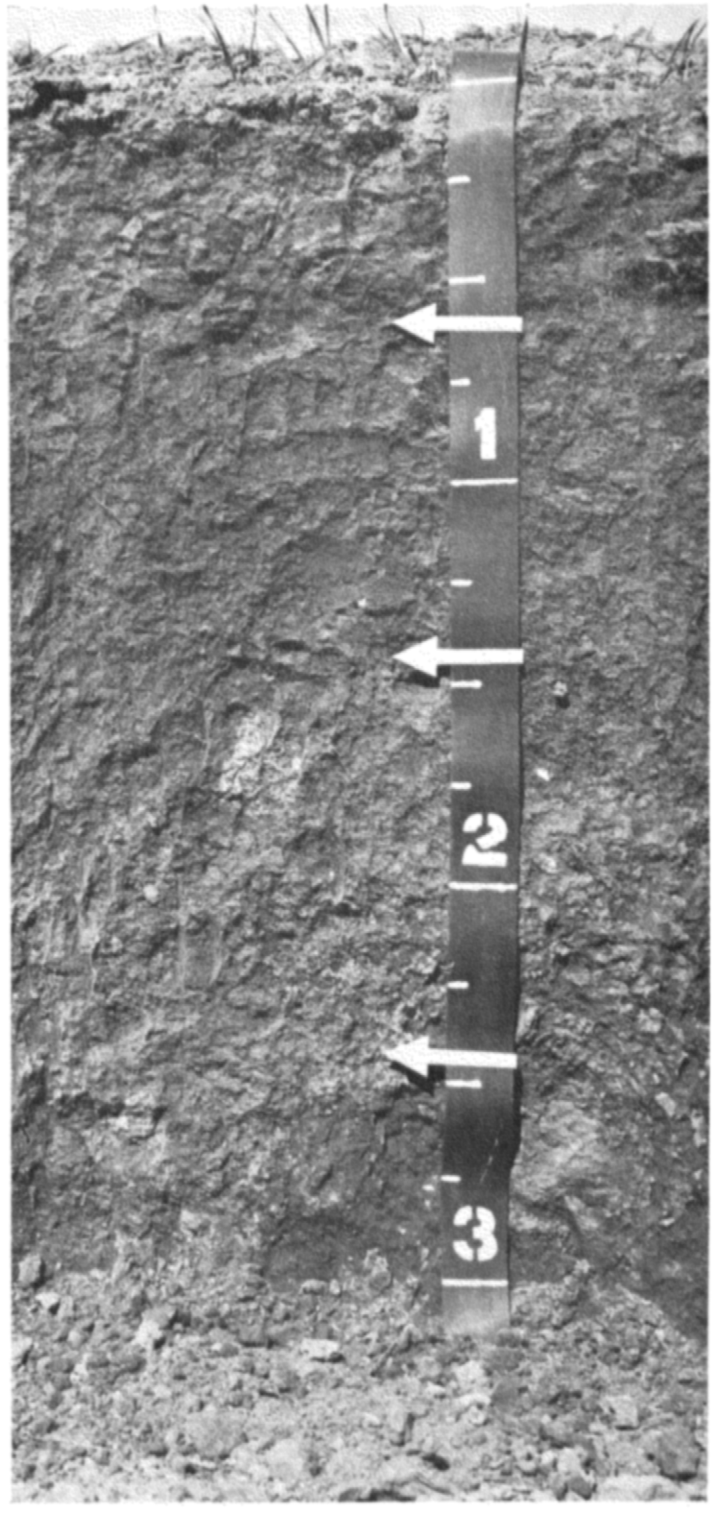

Figure 8.—**Profile of Goshen silt loam.**

These soils are used for cultivated crops and native grass range. Wheat and sorghum are the most common crops. Alfalfa, corn, and sugar beets are grown in irrigated areas.

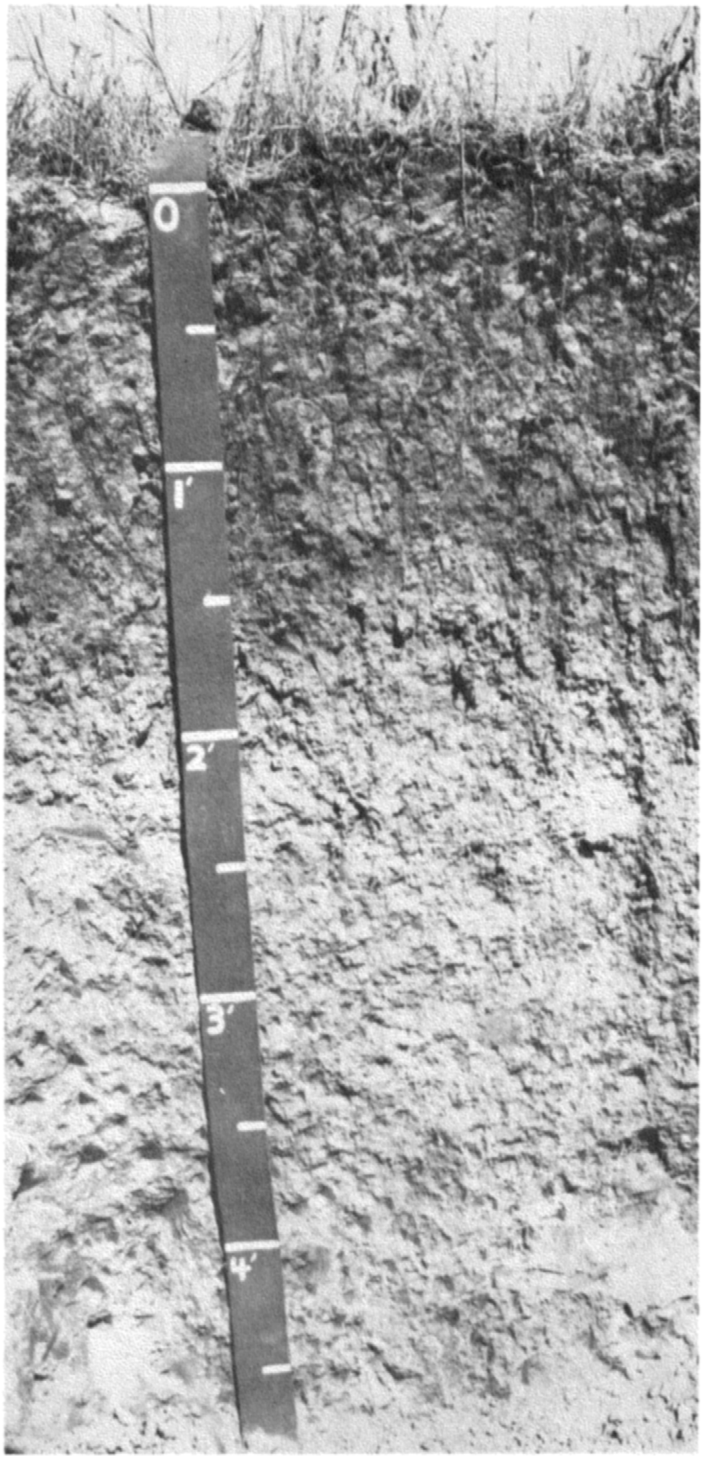

Figure 9.—**Profile of a Keith silt loam. Lower part is a buried soil.**

Representative profile of Keith silt loam, 0 to 1 percent slopes, in a cultivated field, 1,640 feet north and 850 feet west of the southeast corner of section 4, T. 8., R. 42 W.:

Ap—0 to 3 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; neutral; clear, smooth boundary.

A1—3 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; neutral; clear, smooth boundary.

B21t—6 to 14 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; slightly hard when dry, firm when moist; noncalcareous; neutral; gradual, smooth boundary.

B22tb—14 to 20 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; many worm casts; noncalcareous; mildly alkaline; gradual, smooth boundary.

B3bca—20 to 37 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) when moist; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; films and soft concretions of lime; moderately alkaline; gradual, smooth boundary.

C—37 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist; calcareous; moderately alkaline.

The Ap and A1 horizons combined range from 6 to 12 inches in thickness and from grayish brown to dark grayish brown in color. The texture is silt loam or silty clay loam. The B2t horizon ranges from 6 to 14 inches in thickness and from grayish brown to very dark grayish brown in color. In most places the lower part of the solum is a dark-colored, buried soil. The depth to calcareous material averages about 20 inches but ranges from 14 to 30 inches.

Keith soils are associated with Colby, Goshen, Pleasant, Richfield, Roxbury, and Ulysses soils. They are noncalcareous to a greater depth than Colby, Roxbury, and Ulysses soils, and they have a B2t horizon, which those soils lack. Their B2t horizon is less clayey than that of Richfield and Pleasant soils. The dark color in Keith soils extends to a lesser depth than in Goshen soils.

Keith silt loam, 0 to 1 percent slopes (Ke).—This soil is on smooth, loess-covered uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Goshen and Pleasant soils and small areas of more clayey soils and of limy soils. The inclusions of Pleasant soils are indicated on the soil map by depression spot symbols. The small acreage of more clayey soils is indicated by the clayey spot symbol and limy areas by the limy spot symbol.

Runoff is slow. Controlling soil blowing and water erosion, and conserving moisture are the main problems.

This soil is used mainly for cultivated crops. Only a few areas are in native grass range. The soil is well suited to all the commonly grown dryland and irrigated crops and to native grass range (fig. 10). Capability unit IIc-1 (dryland), unit I-1 (irrigated); Loamy Upland range site; Upland windbreak group.

Keith silt loam, 1 to 3 percent slopes (Kh).—This soil is on short slopes of the uplands and on weakly concave sides of U-shaped drainageways. Its profile is similar to the one described as representative for the series, except that calcareous material is at a depth of about 17 inches.

Included in mapping are small areas of Pleasant soils, clayey soils, and limy soils. Inclusions of Pleasant soils are indicated on the soil map by depression spot symbols; those of clayey soils by the clayey spot symbol; and those of limy soils by the limy spot symbol.

Runoff is medium. Controlling soil blowing and water erosion and conserving moisture are the main problems.

This soil is used mainly for cultivated crops. Only a few areas are in native grass range. The soil is suited to all

the commonly grown dryland and irrigated crops and to native grass range. Capability unit IIe-1 (dryland), unit IIe-1 (irrigated); Loamy Upland range site; Upland windbreak group.

Keith-Ulysses silt loams, 0 to 1 percent slopes (Ku).—This mapping unit is on smooth, loess-covered uplands. It is about 70 percent Keith silt loam and 30 percent Ulysses silt loam. Ulysses soils occupy roughly circular areas, 25 to 200 feet in diameter, within larger areas of Keith soils. The Ulysses soil has the profile described as representative for the Ulysses series. The Keith soil has a profile similar to that described for the Keith series, except that the average depth to calcareous material is about 18 inches.

Included in mapping are small areas of Pleasant soils, clayey soils, and limy soils. Inclusions of Pleasant soils are indicated by the depression spot symbol, and those of the clayey and limy soils by the clayey and limy spot symbols.

Runoff is slow. Controlling soil blowing and water erosion and conserving moisture are the main problems.

These soils are used mainly for cultivated crops. A few areas are in native grass range. The soils are well suited to all the commonly grown dryland and irrigated crops and to native grass range. Capability unit IIc-1 (dryland), unit I-1 (irrigated); Loamy Upland range site; Upland windbreak group.

Pleasant Series

The Pleasant series consists of deep, moderately well drained, moderately fine textured soils in undrained depressions on uplands. The depressions are round, oblong, or somewhat irregular in shape. They have a concave surface and no outlets for surface water (fig. 11). Slopes range from 0 to 2 percent.

In a representative profile the surface layer is light silty clay loam about 16 inches thick. The top 9 inches is gray, and the lower 7 inches is grayish brown. The subsoil is very firm silty clay about 44 inches thick. The top 34 inches is gray, and the lower 10 inches is grayish brown.

Pleasant soils have very slow permeability and high available water capacity. They receive runoff from the surrounding uplands. This water ponds and in many places damages the vegetation. Fertility is high.

These soils are used for native grass range and cultivated crops. Most areas are cultivated with the surrounding soil. Wheat and sorghum are the main crops.

Representative profile of Pleasant silty clay loam in native grass range, 800 feet north and 100 feet east of the southwest corner of section 26, T. 7 S., R. 39 W.:

A11—0 to 9 inches, gray (10YR 5/1) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium to coarse, platy structure breaking to weak, very fine, granular; slightly hard when dry, friable when moist; mildly alkaline; clear, smooth boundary.

Figure 10.—**Harvesting alfalfa on an irrigated Keith silt loam.**

Figure 11.—Typical area of a Pleasant soil ponded after a rain.

A12—9 to 16 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (19YR 3/2) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; few old root channels; few worm casts; moderately alkaline; gradual, smooth boundary.

B21t—16 to 50 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) when moist; strong, fine to very fine, subangular blocky structure; very hard when dry, very firm when moist; some worm casts and root channels in top 10 inches; moderately alkaline; gradual, smooth boundary.

B22t—50 to 60 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; weak, fine, blocky structure; very hard when dry, very firm when moist; moderately alkaline.

The A horizon ranges from 10 to 18 inches in thickness. Its color ranges from dark gray to grayish brown, and its texture from heavy silt loam to silty clay loam. The B2t horizon ranges from 20 to 60 inches in thickness and from dark gray to grayish brown in color. The texture is silty clay or clay. The thicker, more clayey profiles are in the larger depressions. Where a C horizon occurs within a depth of 60 inches, it is silt loam to light silty clay. Depth to calcareous material ranges from 30 to 72 inches.

Pleasant soils have a more clayey B2t horizon than the associated Keith, Goshen, and Richfield soils.

Pleasant silty clay loam (0 to 2 percent slopes) (Pe).—This soil is on the nearly level bottoms of undrained depressions (fig. 12).

Ponding of surface water is the main hazard. Water sometimes ponds long enough to delay planting or harvesting. Frequently, crops are damaged; they fail or have to be replanted. Soil blowing is also a hazard if the surface is dry and unprotected.

This soil is not well suited to the crops commonly grown, but it is usually cultivated with the surrounding soils. Some areas are in native grass. Capability unit IVw–1 (dryland), unit IVw–1 (irrigated); Clay Upland range site; no windbreak group.

Richfield Series

The Richfield series consists of deep, well-drained, medium-textured soils on uplands. These soils formed in deep, calcareous loess. Slopes range from 0 to 1 percent.

In a representative profile the surface layer is grayish-brown silt loam about 4 inches thick. The subsoil is about 23 inches thick; the top 11 inches is dark-gray, friable silty clay loam; and the lower part is light-gray, friable silt loam. The underlying material is light-gray silt loam that extends to a depth of 60 inches.

Richfield soils have moderately slow permeability and high available water capacity. Runoff is slow. Fertility is high.

These soils are used for cultivated crops and native grass range. Wheat and sorghum are the principal crops.

Representative profile of Richfield silt loam, 0 to 1 percent slopes, in a cultivated field, 100 feet north and 1,980 feet east of the southwest corner of section 25, T. 10 S., R. 42 W.:

Ap—0 to 4 inches, grayish-brown (10YR 5/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; neutral; clear, smooth boundary.

B2t—4 to 15 inches, dark-gray (10YR 4/1) heavy silty clay loam, very dark grayish brown (10YR 3/2) when moist; strong, very fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; neutral; gradual, smooth boundary.

B3ca—15 to 27 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; white coatings of free lime on peds; moderately alkaline; gradual, smooth boundary.

C—27 to 60 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; massive; porous; soft when dry, friable when moist; calcareous; moderately alkaline.

The Ap horizon ranges from 4 to 8 inches in thickness, from dark gray to grayish brown in color, and from loam to light silty clay loam in texture. The B2t horizon is 8 to 14 inches thick. It ranges from dark gray to dark grayish brown in color and from silty clay loam to light silty clay in texture. The depth to calcareous material ranges from 12 to 22 inches.

Richfield soils are associated with Colby, Goshen, Keith, Pleasant, and Ulysses soils. They have a more clayey B2t horizon than Keith and Goshen soils. They are deeper to calcareous material than Colby soils, and they have a B2t horizon, which Colby and Ulysses soils lack. Their B2t horizon is less clayey than that of Pleasant soils.

Richfield silt loam, 0 to 1 percent slopes (Rc).—This soil is on smooth, loess-covered uplands.

Included in mapping are small areas of Pleasant soils, indicated on the soil map by the depression spot symbol, and areas of limy soils, indicated by the limy spot symbol.

Controlling soil blowing and water erosion and conserving moisture are the main problems.

The soil is used mainly for cultivated crops. Only a few areas are in native grass range. The soil is well suited to all of the commonly grown dryland and irrigated crops and to native grass range. Capability unit IIc–1 (dryland), unit I–1 (irrigated); Loamy Upland range site; Upland windbreak group.

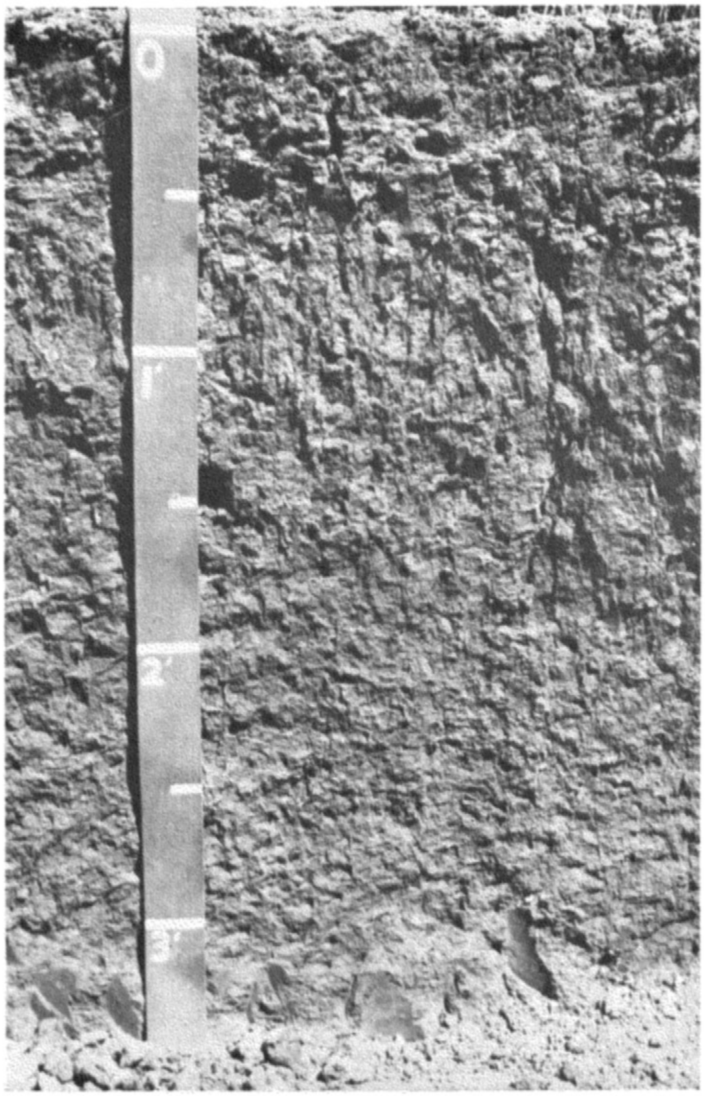

Figure 12.—**Profile of Pleasant silty clay loam.**

Rough Broken and Gravelly Land

Rough broken and gravelly land (6 to 40 percent slopes) (Rh) is on side slopes of deeply entrenched drainageways (fig. 13). Slopes are irregular and broken. About 50 to 65 percent of this mapping unit is highly calcareous, moderately deep to deep, loamy soils. Coarse-textured, gravelly soils make up about 10 to 25 percent of the mapping unit. These soils are calcareous in most places, but in some places the upper 8 inches is noncalcareous. Calcareous, shallow, loamy soils make up 10 to 20 percent of the mapping unit (fig. 14), and outcrops of caliche about 10 percent. There are a few gravel pits. They are indicated on the soil map by the gravel pit spot symbol.

Rough broken and gravelly land is well drained to excessively drained. Runoff is excessive, permeability is moderate to moderately rapid, and the available water capacity is low to high. Fertility is low to high. Controlling erosion and runoff is the main problem.

This land is used for native grass range. It is not suited to cultivated crops. Capability unit VIe–2 (dryland), no irrigated unit or windbreak group; Limy Upland range site for the moderately deep to deep, loamy soils. Sandy range site for the coarse-textured, gravelly soils, Shallow Limy range site for the shallow, loamy soils.

Roxbury Series

The Roxbury series consists of deep, well-drained, medium-textured soils that are calcareous within 14 inches of the surface. These soils are on terraces and flood plains. They formed in deep, calcareous alluvium. Slopes range from 0 to 2 percent.

In a representative profile the surface layer is gray silt loam about 12 inches thick. The next layer is about 28 inches thick; the top 16 inches is dark-gray, friable silty clay loam, and the lower 12 inches is light brownish-gray, friable silt loam. The underlying material is light-gray silt loam.

Roxbury soils receive extra water as runoff from the adjacent uplands. They are sometimes flooded; the frequency of flooding depends on their position in the valley. Permeability is moderate, and the available water capacity is high. Runoff is slow. Fertility is high.

Most areas are cultivated. Wheat, sorghum, corn, and alfalfa are the main crops. Some areas are irrigated.

Representative profile of Roxbury silt loam in a cultivated field, 1,056 feet north and 110 feet east of the southwest corner of section 21, T. 6 S., R. 38 W.:

Ap—0 to 6 inches, gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, very fine, granular structure; slightly hard when dry, friable when moist; few worm casts; noncalcareous; neutral; clear, smooth boundary.

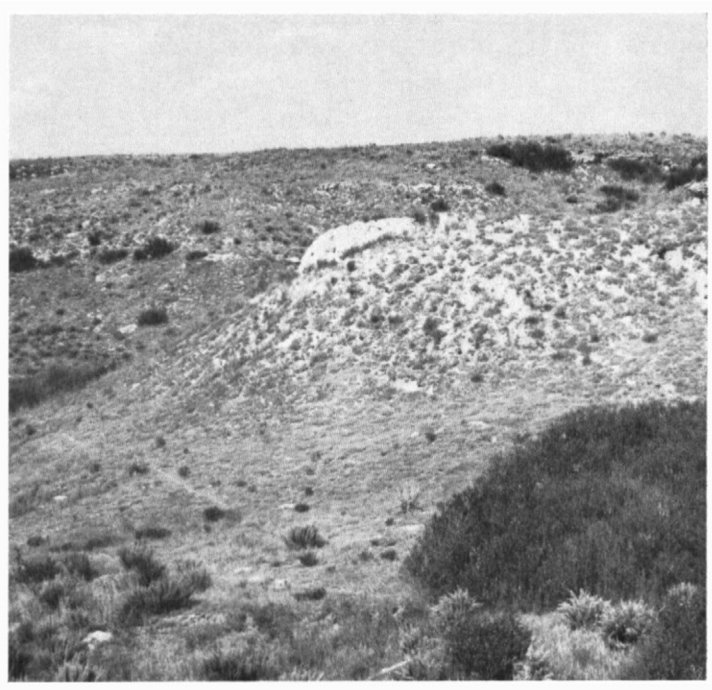

Figure 13.—**Typical landscape of Rough broken and gravelly land.**

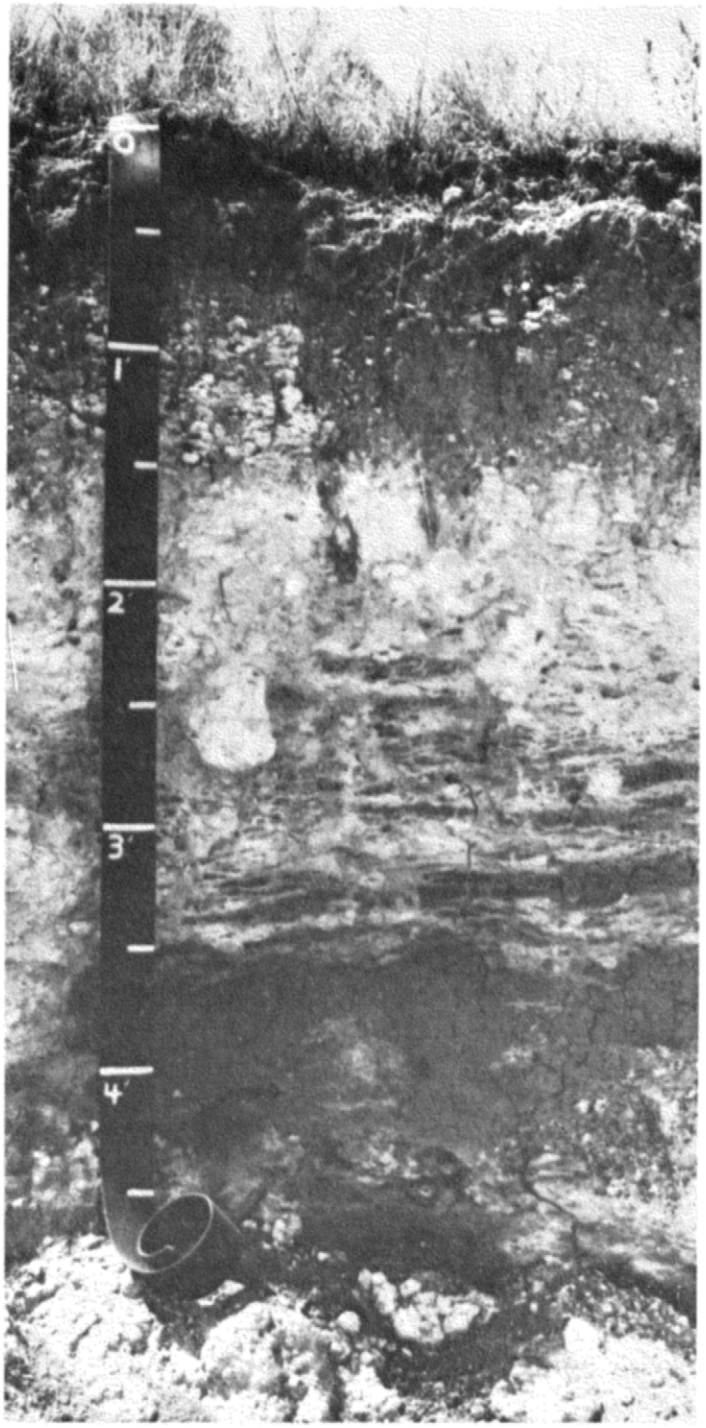

Figure 14.—**Profile of the shallow soil in Rough broken and gravelly land.**

A1—6 to 12 inches, gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; numerous worm casts; noncalcareous; neutral; gradual, smooth boundary.

AC1—12 to 28 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; numerous worm casts; weakly calcareous; few, fine, soft concretions of lime; moderately alkaline; gradual, smooth boundary.

AC2—28 to 40 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; contains strata with colors like those in AC1 horizon; weak, very fine, granular structure; porous; slightly hard when dry, friable when moist; calcareous; few fine spots of lime; moderately alkaline; gradual, smooth boundary.

C—40 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; massive; porous; calcareous; lime coatings in some old root channels; moderately alkaline.

The Ap and A1 horizons combined are 10 to 20 inches thick. They range from gray to dark grayish brown in color and from silt loam to silty clay loam in texture. The AC horizon is 12 to 30 inches thick. In most places it is weakly stratified in color and texture. The color ranges from dark gray to light brownish gray but is grayish brown or darker to a depth of 20 inches or more. The texture is silt loam or silty clay loam. Depth to calcareous material ranges from the surface down to 14 inches.

Roxbury soils are associated with Bridgeport, Caruso, Goshen, Keith, and Ulysses soils. They are dark colored to a greater depth than Bridgeport and Ulysses soils. They are less deep over calcareous material than Goshen and Keith soils and lack the B2t horizon typical of those soils. They lack the mottling and the high water table that is characteristic of Caruso soils.

Roxbury silt loam (0 to 2 percent slopes) (Ro).—This soil is on terraces and high flood plains along stream valleys. It has the profile described as representative for the series.

Included in mapping are small areas of Caruso soils and narrow stream channels.

This soil is occasionally flooded. Controlling soil blowing and flooding and conserving moisture are the main problems.

This soil is used mainly for cultivated crops. Only a few areas are in native grass range. The soil is well suited to the commonly grown dryland and irrigated crops and to native grass range. Capability unit IIc–2 (dryland), unit I–2 (irrigated); Loamy Terrace range site; Upland windbreak group.

Roxbury silt loam, frequently flooded (0 to 2 percent slopes) (Rx).—This soil is on low flood plains in stream valleys. Its profile is similar to the one described as representative for the series.

Included in mapping are small areas of Caruso soils and narrow stream channels.

This soil is frequently flooded. Controlling soil blowing and flooding and conserving moisture are the main problems.

This soil is used mainly for cultivated crops. Only a few areas are in native grass range. The soil is suited to the commonly grown dryland and irrigated crops and to native grass range. Capability unit IIIw–2 (dryland), unit IIw–2 (irrigated); Loamy Lowland range site; Lowland windbreak group.

Ulysses Series

The Ulysses series consists of deep, well-drained, medium-textured soils that are calcareous within 14 inches of the surface. These soils formed in deep, calcareous loess on the upland (fig. 15). Slopes range from 0 to 10 percent.

In a representative profile the surface layer is 11 inches of grayish-brown silt loam. The next layer is 5 inches of

light brownish-gray, friable silt loam. The underlying material is light-gray silt loam.

Ulysses soils have moderate permeability and high available water capacity. Runoff is slow to rapid. Fertility is high.

These soils are used for cultivated crops and native grass range. Wheat and sorghum are the main crops.

Representative profile of Ulysses silt loam, 1 to 3 percent slopes, in a cultivated field, 130 feet south and 1,100 feet west of the northeast corner of section 19, T. 8 S., R. 37 W.:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; many fine roots; noncalcareous; neutral; abrupt, smooth boundary.

A1—5 to 11 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine and very fine, granular structure; hard when dry, friable when moist; many roots; many worm casts; noncalcareous; mildly alkaline; gradual, smooth boundary.

AC—11 to 16 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; hard when dry, friable when moist; numerous worm casts; few roots; calcareous; moderately alkaline; gradual, smooth boundary.

C1—16 to 20 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist; few roots; strongly calcareous; moderately alkaline; gradual, smooth boundary.

C2—20 to 60 inches, light-gray (10 YR 7/2) silt loam, light brownish gray (10YR 6/2) when moist; massive; slightly hard when dry, friable when moist; few roots; calcareous; moderately alkaline.

The Ap and A1 horizons combined range from 6 to 12 inches in thickness and from dark gray to grayish brown in color. The texture is silt loam or light silty clay loam. The AC horizon is silt loam or light silty clay loam 4 to 10 inches thick. It ranges from pale brown to grayish brown in color. Depth to calcareous material ranges from the surface down to 14 inches.

Ulysses soils are associated with Colby, Goshen, Keith, Richfield, and Roxbury soils. They are darker colored in the top 7 inches than Colby soils. They are shallower over calcareous material than Goshen and Keith soils and lack the B2t horizon typical of those soils. They lack the B2t horizon typical of Richfield soils. They are dark colored to a lesser depth than Roxbury soils.

Ulysses silt loam, 1 to 3 percent slopes (Ua)—This soil is on smooth, loess-covered uplands. It has the profile described as representative for the series.

Included in mapping are small areas of more clayey soils, indicated on the soil map by the clayey spot symbol; areas of rock outcrops, by the rock-outcrop symbol; gravelly areas, by the gravel spot symbol; limy areas, by the limy spot symbol; and small areas of Pleasant soils, by the depression spot symbol.

Runoff is medium. Controlling soil blowing and water erosion and conserving moisture are the main problems.

This soil is used mainly for cultivated crops. The soil is well suited to all the dryland and irrigated crops grown in the county and to native grass range. Only a few areas are in native grass range. Capability unit IIIe-1 (dryland), unit IIe-1 (irrigated); Loamy Upland range site; Upland windbreak group.

Ulysses silt loam, 3 to 6 percent slopes (Ub).—This soil is on loess-covered uplands along the sides of U-shaped drainageways and on convex ridgetops. Its profile is similar to the one described as representative for the series. Depth to calcareous material ranges from the surface to 12 inches.

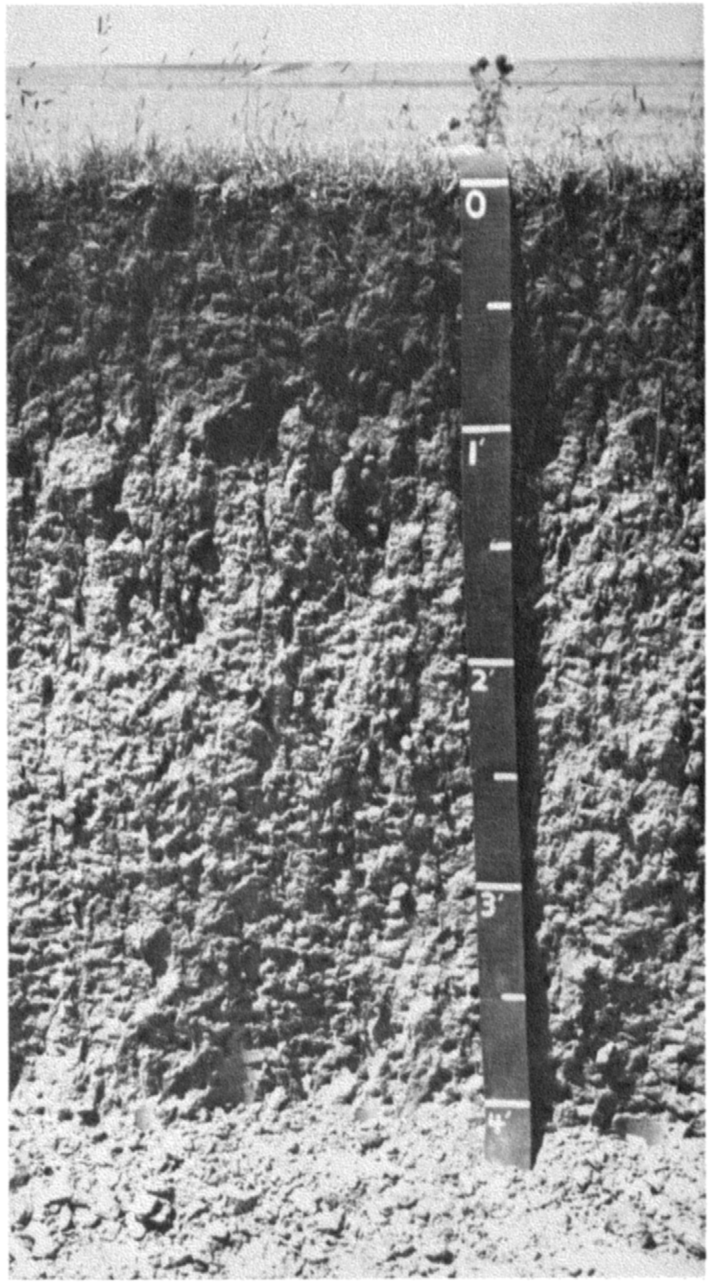

***Figure 15.*—Profile of Ulysses silt loam.**

Included in mapping are small areas of more clayey soils, indicated on the soil map by the clayey spot symbol; areas of rock outcrops, by the rock-outcrop symbol; gravelly areas, by the gravelly spot symbol; limy areas, by the limy spot symbol; and small areas of Pleasant soils, by the depression spot symbol.

Runoff is medium. Controlling water erosion and soil blowing and conserving moisture are the main problems.

This soil is used for cultivated crops and for native grass range. It is not so well suited to cultivated crops as the less sloping Ulysses soils but is well suited to native grass range. Capability unit IVe-1 (dryland), unit IIIe-1 (irrigated); Loamy Upland range site; Upland windbreak group.

Ulysses silt loam, 6 to 10 percent slopes (Uc).—This soil is on loess-covered uplands, mainly along the sides of U-shaped drainageways. Its profile is similar to the one described as representative for the series. Depth to calcareous material ranges from the surface to 12 inches. The dark-colored surface layer is 6 to 8 inches thick.

Included in mapping are areas of rock outcrops, indicated on the soil map by the rock-outcrop symbol; gravelly areas, by the gravel spot symbol; limy areas, by the limy spot symbol; small areas of Pleasant soils, by the depression spot symbol; and a few gravel pits, by the gravel pit symbol.

Surface runoff is rapid. Water erosion and soil blowing are severe hazards in cultivated or unprotected areas.

This soil is well suited to native grass range and is used mainly for this purpose. Only a few areas are cultivated. Capability unit VIe–1 (dryland), no irrigated unit; Loamy Upland range site; Upland windbreak group.

Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded (Ud).—This mapping unit is on smooth, loess-covered uplands. It is about 60 percent Ulysses soils and 40 percent Colby soils. The Ulysses soil is on the lower side slopes. Its profile is similar to the one described as representative for the Ulysses series but has been thinned by erosion and is calcareous to the surface in most places. The Colby soil is mainly on the convex ridgetops and upper slopes where erosion has been most severe. Its profile is similar to the one described as representative for the Colby series but has been formed by erosion of the Ulysses soil.

Runoff is medium. Controlling soil blowing and water erosion and conserving moisture are the main problems.

This soil is used for cultivated crops. It is suited to all the commonly grown dryland and irrigated crops and to native grass range. Capability unit IIIe–1 (dryland), unit IIe–1 (irrigated); Limy Upland range site; Upland windbreak group.

Ulysses-Keith silt loams, 0 to 1 percent slopes (Uk).—This mapping unit is on smooth, loess-covered uplands. It is about 70 percent Ulysses silt loam and 30 percent Keith silt loam. The profile of the Ulysses soil is similar to the one described as representative for the Ulysses series; calcareous material is at a depth of 6 to 14 inches in most places but is at the surface in some cultivated areas. The profile of the Keith soil is similar to the one described as representative for the Keith series, except that the average depth to calcareous material is about 18 inches.

Included in mapping are small areas of Pleasant soils, indicated on the soil map by the depression spot symbol. Also included are limy areas, indicated by the limy spot symbol.

Runoff is slow. Controlling soil blowing and water erosion and conserving moisture are the main problems.

Most of the acreage is cultivated. Only a few areas are in native grass range. The soil is well suited to the commonly grown dryland and irrigated crops and to native grass range. Capability unit IIc–1 (dryland), unit I–1 (irrigated); Loamy Upland range site; Upland windbreak group.

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wa) is on the flood plains of streams where the water table is high. In most places it is bordered by nonarable slopes (fig. 16). The alluvial bottoms are more than 150 feet wide.

This mapping unit is highly variable. In most places the soil material is loam or clay loam to a depth of 18 to 30 inches. Below this is gravelly loamy sand.

Included in mapping are small areas of Caruso loam and some small areas where the water table is not significantly high.

This land is poorly drained. Runoff is slow, and permeability is moderate. The water table is high all year, ordinarily within a depth of 3 feet. In winter, early in spring, and during periods of high rainfall, free water is at a depth of 18 inches or less, and in some places it is at the surface. Salinity is slight to moderate; accumulations of white salts are common on the surface.

Wet alluvial land is used for native grass range and hay meadows. It is not suited to cultivated crops but is well suited to native grass range and hay. Capability unit Vw–1 (dryland), no irrigated unit or windbreak group; Wet Land range site.

Use and Management of the Soils

This section explains the capability classification used by the Soil Conservation Service. Then it describes the general management in Sherman County, and the management by capability units for both dryland and irrigated crops. Yields for dryland and irrigated crops are predicted for high level management for the arable soils in the county. This section also gives suggestions on managing the soils for range, windbreaks, and wildlife habitat.

The county agricultural agent or the local technician of the Soil Conservation Service can furnish additional information.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive

***Figure 16.*—Typical area of Wet alluvial land along a small stream.**

landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat. (No class VII soils in Sherman County.)

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes. (No class VIII soils in Sherman County.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIw-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages are suggestions on general management and management by capability units of the dryland and irrigated soils in Sherman County.

Management of Dryland Soils

Wheat, grain sorghum, and forage sorghum are the principal dryland crops in Sherman County. Alfalfa is grown on bottom land, in areas that receive runoff from uplands.

Good management practices are those that reduce runoff and the risk of erosion, conserve moisture, and improve fertility. Among these practices are suitable cropping sequences, including summer fallow, crop residue management, level terraces, contour farming, stubble-mulch tillage, and minimum tillage.

The use and management of dryland soils by capability unit are described in the following pages. The capability designation for each dryland soil in the county is given in the "Guide to Mapping Units" at the back of this survey.

Capability unit IIe-1 (dryland)

Keith silt loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, well-drained soil on uplands. The surface layer is silt loam, and the subsoil is silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is high.

Conserving moisture and controlling water erosion are problems in cultivated areas. Soil blowing is a hazard in bare areas. Terracing, contour farming, and stubble mulching help to conserve moisture and control erosion. Contour stripcropping, minimum tillage, and limited grazing of crop residue are other suitable practices.

Most of the acreage is cultivated. The soil is well suited to cultivated crops and native grass range. Wheat and sorghum are the main crops.

Capability unit IIc-1 (dryland)

This unit consists of deep, well-drained, nearly level soils of the uplands. These soils have a surface layer of silt loam and a subsoil of silt loam or silty clay loam. Permeability is moderate or moderately slow, and the available water capacity is high. Fertility is high.

Conserving moisture is the main problem. Soil blowing is a hazard in bare areas. Water erosion is a slight hazard on some long slopes. Stubble mulching and contour farming help in conserving moisture and controlling erosion.

Terracing, contour stripcropping, minimum tillage, and limited grazing of crop residue are other suitable practices.

Most of the acreage is cultivated. The soils are well suited to cultivated crops and native grass range. Wheat and sorghum are the main crops.

Capability unit IIc-2 (dryland)

This unit consists of deep, well-drained, nearly level soils in upland swales and on terraces or alluvial fans. The surface layer is silt loam, and the subsoil is silt loam or silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is high.

Conserving moisture is the main problem. Soil blowing is a hazard in bare areas. In some places diversions are needed to control runoff from the adjacent uplands. Stubble mulching helps in conserving moisture and controlling erosion. Minimum tillage and limited grazing of crop residue are other suitable practices.

Most of the acreage is cultivated. The soils are well suited to cultivated crops and native grass range. Wheat, sorghum, and alfalfa are the main crops. Some areas of native grass are cut for hay.

Capability unit IIIe-1 (dryland)

This unit consists of deep, well-drained soils on uplands, fans, terraces, and foot slopes. Slopes range from 1 to 4 percent. The surface layer and subsoil are silt loam. Permeability is moderate, and the available water capacity is high. Fertility is medium to high.

Conserving moisture and controlling water erosion are the main problems. Soil blowing is a hazard in bare areas. Terracing, contour farming, and stubble-mulch tillage help in conserving moisture and controlling erosion. Contour stripcropping, minimum tillage, and limited grazing of crop residue are other suitable practices.

Most of the acreage is cultivated. The soils are well suited to cultivated crops and native grass range. Wheat and sorghum are the main crops.

Capability unit IIIw-1 (dryland)

Caruso loam is the only soil in this unit. It is a deep, nearly level, moderately well drained to somewhat poorly drained soil on flood plains. It has loam texture throughout. Permeability is moderate. The water table is usually at a depth of 4 to 8 feet but rises to within 2 feet of the surface during wet periods. The available water capacity is high. Fertility is medium.

Flooding, a fluctuating water table, slight to moderate salinity, and a shortage of moisture are problems. Soil blowing is a hazard in bare areas. In some places diversions are needed to control runoff from the adjacent uplands. Stubble mulching helps to conserve moisture and control erosion. Minimum tillage and limited grazing of crop residue are other suitable practices.

Most of the acreage is used for native grass range or hay. The soils are suited to native grass and cultivated crops. Sorghum and alfalfa are the main crops.

Capability unit IIIw-2 (dryland)

Roxbury silt loam, frequently flooded, is the only soil in this unit. It is a deep, nearly level, well-drained soil on flood plains. The surface layer is silt loam, and the lower layers are silt loam or silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is high.

Flooding and conserving moisture are problems. Soil blowing is a hazard in bare areas. In some places diversions are needed to control runoff from adjacent uplands. Stubble mulching helps in conserving moisture and controlling erosion. Minimum tillage and limited grazing of crop residue are other suitable practices.

Most of the acreage is cultivated. Only a few areas are in native grass range. The soil is suited to cultivation and to native grass range. Sorghum and alfalfa are the main crops.

Capability unit IVe-1 (dryland)

This unit consists of deep, well-drained soils on the uplands. Slopes are 3 to 6 percent. The surface layer is silt loam, and the lower layers are silt loam or light silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is medium to high.

Controlling water erosion and conserving moisture are the main problems. Controlling soil blowing is a problem also if the soils are bare. Sorghum grown on these soils is subject to iron chlorosis. Terracing, contour farming, and stubble-mulch tillage are important practices in conserving moisture and controlling erosion. Minimum tillage and limited grazing of crop residue are other suitable practices.

These soils are used for cultivated crops and native grass range. Wheat and sorghum are the main crops.

Capability unit IVw-1 (dryland)

Pleasant silty clay loam is the only soil in this unit. It is a deep, nearly level, ponded soil in undrained depressions in the uplands. It has a surface layer of silty clay loam and a subsoil of silty clay or clay. Permeability is very slow, and the available water capacity is high. Fertility is high.

Ponded surface water often damages crops. Soil blowing is a problem in bare areas. The hazard of ponding can be reduced by terracing, contour farming, and stubble-mulch tillage of the adjoining soils. Maintaining a good cover reduces the hazard of soil blowing.

This soil is not well suited to the crops commonly grown, but most of the acreage is cultivated with adjoining soils. Wheat and sorghum are the main crops. Some areas are in native grass.

Capability unit IVs-1 (dryland)

The Bridgeport-Slickspots complex makes up this unit. It consists of deep, nearly level, well-drained to somewhat poorly drained soils on alluvial fans and terraces. Slickspots hold water after a rain. The surface layer is silt loam, and the subsoil ranges from silt loam to silty clay. Permeability is moderate to very slow, and the available water capacity is high. Fertility is low to high.

Tillage is difficult, and the growth of crops is restricted, particularly on the slickspots. Conserving moisture and controlling soil blowing are also problems. Stubble-mulch tillage helps to conserve moisture and control soil blowing in cultivated areas.

Most of the acreage is used for native grass range. Only a few areas are cultivated. The Bridgeport soil is suited to native grass range and cultivated crops, but the slickspots are unproductive and are bare in many places. Wheat and sorghum are the main crops.

Capability unit Vw-1 (dryland)

This capability unit consists of Wet alluvial land. The soil material is loam or clay loam that is underlain by gravelly loamy sand at a depth of 18 to 30 inches. This land is poorly drained, and the water table is high all year; it is seldom more than 3 feet below the surface. In some seasons it is within a depth of 18 inches. Surface accumulations of white salts are common. Permeability is moderate, and the available water capacity is high. Fertility is high.

Wet alluvial land is used for native grass range and hay. It is well suited to grass. The high water table makes it unsuitable for cultivation. The native vegetation is mainly salt-tolerant grasses, forbs, and sedges.

Capability unit VIe-1 (dryland)

This unit consists of deep, well-drained soils on uplands. Slopes range from 6 to 15 percent. The surface layer is silt loam, and the lower layers are silt loam or light silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is medium to high.

Controlling soil blowing and water erosion and conserving moisture are problems. Iron chlorosis of sorghum is also a problem in cultivated areas.

Most of the acreage is used for native grass range. Only a few areas are cultivated. Because of the severe erosion hazard, these soils are better suited to native grass range than to cultivated crops. Many areas that were previously cultivated have been successfully reseeded and are now good rangeland. The native vegetation is mainly short and mid grasses.

Capability unit VIe-2 (dryland)

This unit consists of Rough broken and gravelly land. This land is along the sides of the more deeply entrenched drainageways. The soil material ranges from shallow to deep. This land is well drained to excessively drained. Slopes range from 6 to 40 percent. There are many outcrops of caliche. Permeability is moderate to moderately rapid, and the available water capacity is low to high. Fertility is low to high.

Most of the acreage is used for native grass range. A few small areas extend into cultivated fields. Because of strong slopes and caliche outcrops, this land is better suited to native grass range than to cultivated crops. The native vegetation consists of short and mid grasses and a small amount of tall grasses.

Capability unit VIw-1 (dryland)

This capability unit consists of Alluvial land. The soils in this land type are deep to moderately deep and well drained. They are on the flood plains of local, intermittent streams. Slopes range from 0 to 2 percent. The texture of all layers ranges from sandy loam to light silty clay loam. Permeability is moderate, and the available water capacity is moderate or high. Fertility is high.

This land is subject to flooding, water erosion, and deposition. In most places it is cut by stream channels and is bordered by nonarable slopes. Areas are generally small and are isolated by the stream channels.

Alluvial land is used mainly for native grass range, to which it is well suited. Most areas are not suited to cultivation because they are too small and inaccessible. The native vegetation consists of a mixture of short, mid, and tall grasses.

Predicted Yields of Crops (Dryland)

Table 2 gives predicted average yields per acre of wheat and grain sorghum for the arable soils in the county. The yields obtained are from crops under high level management. The information on which to base precise estimates is limited because no long-term, accurate records of yields are available. Yields fluctuate greatly, mainly as a result of variations in precipitation.

The predictions shown in table 2 were based on data obtained from farmers, from average yields shown in the biennial reports of the Kansas State Board of Agriculture, and from observations of the soil survey party.

The yields of wheat and grain sorghum shown in table 2 are based on the use of—

1. A flexible cropping sequence that fits the operator's needs and maintains the soil in good condition.
2. Crop varieties adapted to the area.
3. Proper seeding rates, dates, and methods of planting, and efficient harvesting methods.
4. Adequate control of weeds, insects, and diseases.
5. A crop residue management program to help control soil blowing and water erosion, to increase water infiltration, and to enhance seedling emergence.
6. Terraces, contour farming, minimum tillage, and other practices that help to control erosion and conserve water.
7. Adequate surface and subsurface drainage.

TABLE 2.—*Predicted average yields per acre of dryland wheat and grain sorghum under high level management*

[Only the arable soils are listed. Yields of wheat reflect use of summer fallow]

Soil	Wheat	Grain sorghum
	Bu.	*Bu.*
Bridgeport silt loam, 0 to 2 percent slopes	26	32
Bridgeport silt loam, 2 to 4 percent slopes	24	30
Bridgeport-Slickspots complex	18	18
Caruso loam	20	24
Colby-Ulysses silt loams, 3 to 6 percent slopes, eroded	16	16
Goshen silt loam	28	38
Keith silt loam, 0 to 1 percent slopes	28	36
Keith silt loam, 1 to 3 percent slopes	27	34
Keith-Ulysses silt loams, 0 to 1 percent slopes	25	34
Pleasant silty clay loam	19	26
Richfield silt loam, 0 to 1 percent slopes	24	32
Roxbury silt loam	25	36
Roxbury silt loam, frequently flooded	22	30
Ulysses silt loam, 1 to 3 percent slopes	22	32
Ulysses silt loam, 3 to 6 percent slopes	20	28
Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded	20	28
Ulysses-Keith silt loams, 0 to 1 percent slopes	24	32

Management of Irrigated Soils

The major management needs on irrigated soils in Sherman County are maintenance of fertility and tilth, efficient use of irrigation water, and control of erosion.

Fertility can be maintained by applying commercial fertilizers as needed, using manure if available, using a crop-

ping sequence that includes legumes, and utilizing crop residue.

Soil tilth is important because it affects the penetration of roots, air, and water and the preparation of a good seedbed. Practices that increase the organic-matter content help improve tilth. Deep-rooted legumes increase the percolation of water and the movement of air in the lower layers. The soil is compacted if worked when wet.

Surface irrigation or sprinkler irrigation is used. Surface irrigation is by flooding in borders or basins or by the corrugation or furrow method.

A well designed irrigation system is needed to conserve water and reduce erosion. Some land leveling is needed for nearly all of the soils in Sherman County. Water can be carried to the fields through open ditches, or through surface or underground pipes. Siphon tubes are used with open ditches; they help to distribute water into furrows, borders, or basins. Gated pipes are used to distribute water from surface or underground pipes. In some places drop structures may be needed to reduce erosion in ditches or from tailwater. Open ditches can be lined to help reduce seepage and erosion. In most places terraces and contour farming are needed to control runoff and erosion if the sprinkler system is used.

The Ogallala Formation is the principal source of water for irrigation in Sherman County. Water is obtained from a few wells in areas along the Smoky Hill River and Prairie Dog Creek.

Several factors should be considered when planning an irrigation system. The soils should be suited to irrigation, and the water should be of good quality and of sufficient quantity.

Wheat, sorghum, corn, alfalfa, and sugar beets are the main crops grown on irrigated soils in the county. Truck crops could be grown successfully on most of the irrigated soils.

The use and management of irrigated soils by capability units are described in the following pages. The capability unit designation for each irrigated soil in the county is given in the "Guide to Mapping Units" at the back of this survey.

Capability unit I-1 (irrigated)

This unit consists of deep, well-drained, nearly level soils on uplands. These soils have a surface layer of silt loam and a subsoil of silt loam or silty clay loam. Permeability is moderate or moderately slow, and the available water capacity is high. Fertility is high.

These soils are well suited to irrigation by flooding. Leveling is needed in most areas for uniform distribution of water (fig. 17). A system that disposes of excess water from both irrigation and precipitation is essential.

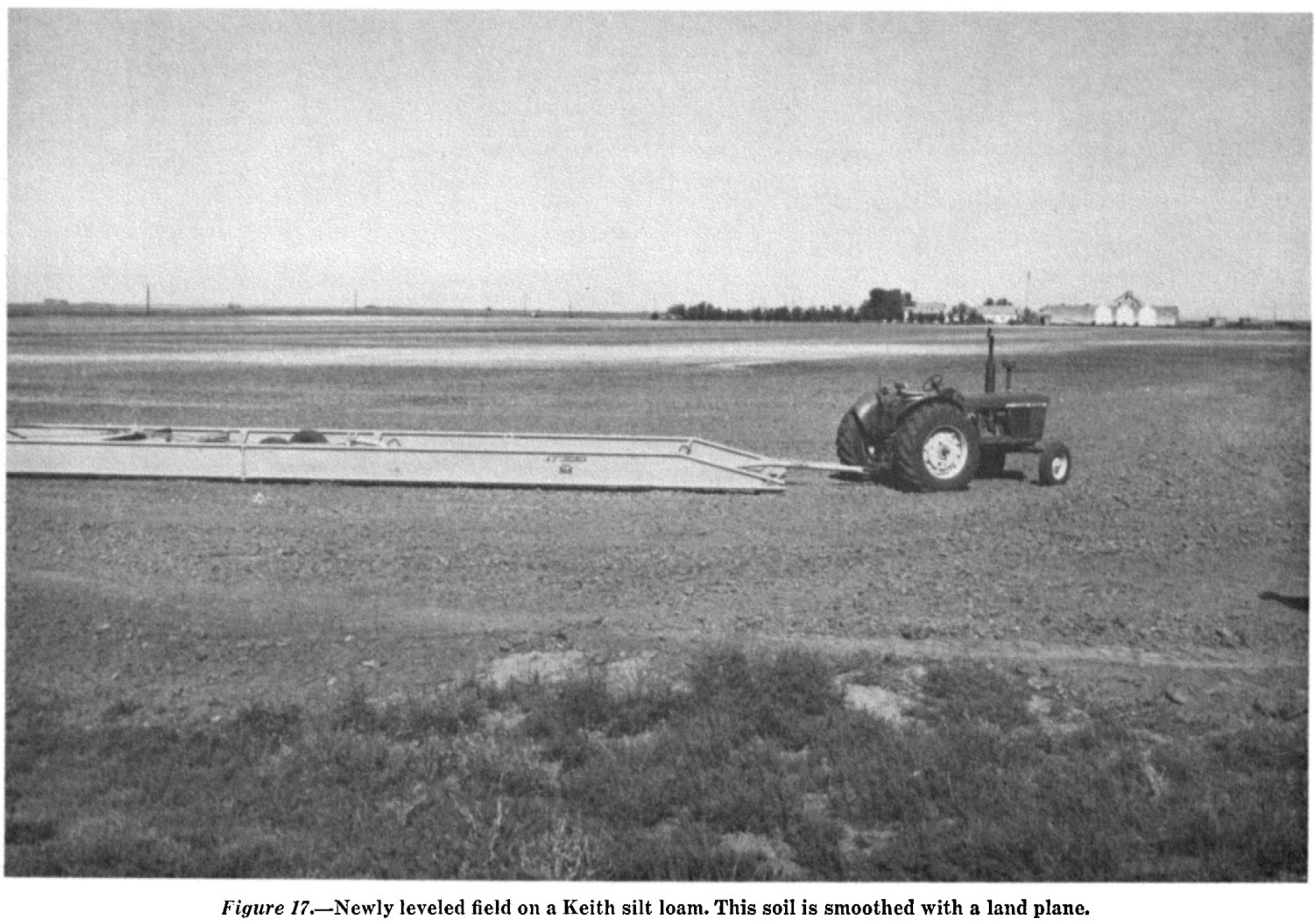

***Figure 17.*—Newly leveled field on a Keith silt loam. This soil is smoothed with a land plane.**

Capability unit I–2 (irrigated)

This unit consists of deep, well-drained, nearly level soils in upland swales and on terraces or alluvial fans. These soils have a surface layer of silt loam and a subsoil of silt loam or silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is high.

These soils are well suited to irrigation, but they need leveling in most areas for uniform distribution of water. In most places protection from the runoff of adjoining areas is needed. Disposing of excess water from both irrigation and precipitation is essential.

Capability unit IIe–1 (irrigated)

This unit consists of deep, well-drained soils on uplands, fans, terraces, and foot slopes. Slopes range from 1 to 4 percent. These soils have a surface layer of silt loam and a subsoil of silt loam or silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is medium or high.

These soils are suitable for irrigation. Sprinklers can be used on close-growing crops if the soils are terraced. For surface irrigation, leveling or irrigating on the contour reduces the risk of erosion. In most places there are no layers that limit the depth of cuts. The organic-matter content, however, is low in areas where deep cuts have been made. Organic matter can be supplied by plowing under crop residue and by adding manure. Disposing of excess water from both irrigation and precipitation is essential. Controlling runoff from adjacent areas is a problem in some areas.

Capability unit IIw–1 (irrigated)

Caruso loam is the only soil in this unit. It is a deep, nearly level, moderately well drained to somewhat poorly drained soil on flood plains. Its texture is loam throughout. Permeability is moderate. The water table is usually at a depth of 4 to 8 feet, but rises to within 2 feet of the surface during wet periods. The available water capacity is high. Fertility is medium. Salinity is slight to moderate.

This soil is suited to irrigation, but proper application of water is important. Salts tend to accumulate on the surface if applications are light. Heavy applications, on the other hand, tend to leach out plant nutrients and cause the water table to rise. Soil and water quality tests help determine the amount of water that should be applied. The root zone is limited by coarse sand and gravel at a depth of 40 to 80 inches. Cuts made in leveling, therefore, should be kept to a minimum.

Capability unit IIw–2 (irrigated)

Roxbury silt loam, frequently flooded, is the only soil in this unit. It is a deep, nearly level, well-drained soil on flood plains. Its surface layer is silt loam. The underlying layers are silt loam or silty clay loam. Permeability is moderate, and the available water capacity is high. Fertility is high.

This soil is suited to irrigation. Leveling is needed in most areas for uniform distribution of water. Flood protection is needed. A system for flood control should be installed if a practical method can be designed for the area that is irrigated.

Capability unit IIIe–1 (irrigated)

This unit consists of deep, well-drained soils on uplands. Slopes range from 3 to 6 percent. The surface layer is silt loam, and the lower layers are silt loam or light silty clay loam. Permeability is moderate. The available water capacity is high. Fertility is medium to high.

These soils are suitable for irrigation, but they need bench leveling for surface irrigation, or terraces and contour farming for sprinkler irrigation. In most places there are no layers that limit the depth of cuts. The organic-matter content, however, is low in areas where deep cuts have been made. These areas can be improved by plowing under crop residue and by heavy applications of manure. A system that disposes of excess water from both irrigation and precipitation is essential.

Capability unit IVw–1 (irrigated)

The one soil in this unit, Pleasant silty clay loam, is a deep, ponded soil in undrained depressions in the uplands. Slopes are 0 to 2 percent. The surface layer is silty clay loam, and the subsoil is silty clay or clay. Permeability is very slow, and the available water capacity is high. Fertility is high.

This soil is suitable for irrigation, but ponding and very slow permeability are problems. Terracing or leveling the adjoining soils helps reduce ponding. Many areas of this soil are leveled with surrounding areas of other soils. This practice is fairly satisfactory if the fill material is deep enough. Because of the very slow permeability of the Pleasant soil, however, it acts as a restrictive layer and tends to limit the penetration of water. The overlying fill material becomes alternately waterlogged and droughty.

Capability unit IVs–1 (irrigated)

The Bridgeport-Slickspots complex makes up this unit. It consists of deep, nearly level, well-drained to somewhat poorly drained soils on alluvial fans and terraces. Slickspots hold water after a rain. Permeability ranges from moderate to very slow. The available water capacity is high. Fertility is low to high.

This complex is suitable for irrigation, but tests for salt and alkali and for water quality should be made if it is to be irrigated. Leveling is needed in most areas, but cuts should be held to a minimum because seedbed preparation is difficult in the subsoil. Crop growth is uneven because the soil material in this complex varies.

Predicted Yields of Crops (Irrigated)

Table 3 gives the predicted average yields per acre of certain crops grown on the arable, irrigated soils in the county. The yields are based on a high level of management.

Irrigation is a recent practice in this county. The information on which to base precise yield predictions, therefore, is limited. The predictions shown are based on data obtained from farmers, from the Kansas Agricultural Experiment Station, and from other agricultural workers.

The yields shown in table 3 are based on the use of—

1. An irrigation system that provides for uniform penetration of water and for control of erosion. Some practices needed for an efficient irrigation

system are land leveling and contour furrowing, and the use of gated pipes and underground pipes.
2. A cropping system that helps to maintain fertility and tilth.
3. Proper seeding rates and dates and methods of planting and harvesting.
4. Crop varieties adapted to the area.
5. Irrigation water in amounts needed to meet the requirements of the crop.
6. Fertilization as needed to provide the optimum level of fertility for the particular crop.
7. Adequate weed, insect, and disease control.
8. Adequate surface and subsurface drainage.
9. Applications of manure, if available.

Range Management [2]

Native grassland makes up about 25 percent, or 165,000 acres, of the farmland in Sherman County. There are two large range areas. One is along the south side of the county, adjacent to the North Fork Smoky Hill River. The other is adjacent to Beaver Creek. About a third of the rangeland is suitable for cultivation. Small tracts occur throughout the county, intermingled with larger acreages of cropland.

Beef production is the second largest farm enterprise. Raising wheat for grain is the most important. Livestock operations consist mostly of grazing stockers and feeders. There are several large cow-calf operations; the calves are kept as feeders. Almost all the ranches include some cropland that is used for supplemental grazing. The chief crops used for temporary grazing are wheat pasture and sorghum stubble. The forage produced is marketed through the sale of livestock and livestock products. Thus, the success of the livestock enterprise depends on management of the range.

The native vegetation consists mainly of a mixture of short and mid grasses. The major range site is Loamy Upland; it has a cover of blue grama, buffalograss, side-oats grama, and western wheatgrass. The next most important site is Limy Upland; the principal grasses are blue grama, side-oats grama, and little bluestem.

Most of the acreage of these two sites is in fair to good condition. Both have smooth topography and are readily accessible to livestock. Consequently, they have been overused for a long time. They are now covered mostly with blue grama and buffalograss. The Shallow Limy site is usually in excellent condition because it is steep and less accessible to grazing livestock. The vegetation consists mainly of side-oats grama, little bluestem, blue grama, and small amounts of big bluestem and switchgrass.

Range sites and condition classes

Different kinds of soils vary in their capacity to produce grass and other plants for grazing. The soils that produce about the same kind and amount of forage make up a range site. Range sites are areas of rangeland that differ in the ability to produce different kinds or amounts of native vegetation. The difference must be great enough to require some change in management, such as a different rate of stocking. Different range sites are not recognized because of differences in soil or in climate, unless these factors result in a significant difference in the potential plant community. Plants on native range respond in one of three ways under grazing.

Decreasers are species in the potential plant community that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are species that increase in relative amount as the more desirable plants are reduced by close grazing. They are commonly shorter, and some are less palatable to livestock than decreasers.

Invaders are plants that cannot withstand the competition for moisture, nutrients, and light in the potential plant community. They invade and grow along with the increasers after the potential vegetation has been reduced by grazing. Many are annual weeds. Some are forbs that have some grazing value, but others have little value for grazing.

[2] By H. RAY BROWN, range conservationist, Soil Conservation Service.

TABLE 3.—*Predicted average yields per acre of irrigated crops under high level management*

[Only the arable soils suited to irrigation are listed]

Soil name	Wheat	Corn (grain)	Sorghum (grain)	Sugar beets	Alfalfa	Sorghum (silage)	Corn (silage)
	Bu.	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Bridgeport silt loam, 0 to 2 percent slopes	50	120	115	20. 5	6	24	21
Bridgeport silt loam, 2 to 4 percent slopes	45	110	100	19. 5	5	21	20
Caruso loam	40	100	90	20. 5	5	20	20
Goshen silt loam	50	120	115	21. 0	6	25	22
Keith silt loam, 0 to 1 percent slopes	50	120	115	21. 0	6	25	22
Keith silt loam, 1 to 3 percent slopes	45	110	110	20	5	24	20
Keith-Ulysses silt loams, 0 to 1 percent slopes	50	120	115	21. 0	6	25	21
Richfield silt loam, 0 to 1 percent slopes	50	120	115	20. 5	6	24	21
Roxbury silt loam	50	120	115	21. 0	6	24	21
Roxbury silt loam, frequently flooded	50	120	110	20. 5	6	22	21
Ulysses silt loam, 1 to 3 percent slopes	45	110	100	19. 5	5	21	20
Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded	40	100	90	19	5	20	20
Ulysses-Keith silt loams, 0 to 1 percent slopes	50	120	115	20. 5	6	24	21

Range condition is the present state of vegetation compared with that of the potential plant community for the site. Classifying range condition provides an approximate measure of the deterioration that has taken place in the plant cover and thus provides a basis for predicting the degree of improvement possible. Four condition classes are defined. Condition is *excellent* if 76 to 100 percent of the vegetation is characteristic of the climax vegetation on the same site; *good* if the percentage is between 51 and 75; *fair* if it is between 26 and 50; and *poor* if it is less than 26.

Range condition is judged by comparing existing kinds and amounts of vegetation with kinds and amounts that would exist in the potential plant community.

Potential forage production depends on the range site. Current forage production depends on the range condition and the amount of moisture available to plants during the growing season.

One of the main objectives of good range management is to keep the range in excellent or good condition; if this is done water is conserved, forage yields are improved, and the soils are protected. Recognizing important changes in the plant cover on a range site is a problem. The changes take place gradually and can be miscalculated or overlooked. Growth following heavy rainfall, for example, may make the range appear to be in good condition when actually the cover is weedy and productivity is declining. On the other hand, carefully managed rangeland that has been closely grazed for relatively short periods may have a degraded appearance that temporarily conceals its quality and its ability to recover.

Descriptions of the range sites

The range sites in Sherman County are Loamy Upland, Loamy Terrace, Loamy Lowland, Limy Upland, Clay Upland, Sandy, Shallow Limy, Wet Land, and Saline Subirrigated (fig. 18). These sites vary greatly in the amount of forage they produce. The total annual yield of forage varies also from year to year because of differences in the amount of precipitation, in amount of grazing in past years, and in relief. In addition, trampling or the activities of rodents and insects may damage the forage plants or cause them to disappear.

The range sites are described in the following pages. The description of each site includes the dominant vegetation and the yield per acre when the site is in excellent condition. The approximate total annual yield per acre of air-dry herbage is given for favorable and less favorable years.

The names of the soil series represented are given in the description of each range site, but this does not mean that all the soils of a given series are in the site. The range site designation for each soil in the county can be found in the "Guide to Mapping Units" at the back of this survey and at the end of the description of that soil in the section "Descriptions of the Soils."

LOAMY UPLAND RANGE SITE

This site consists of deep soils of the Keith, Richfield, and Ulysses series. These soils have a surface layer of silt loam and a subsoil of silt loam or silty clay loam. The permeability of these soils is moderate or moderately slow, and the available water capacity is high. Fertility is high. Water erosion and soil blowing are hazards in unprotected areas.

The potential plant community consists mostly of mid and short grasses. It is about 50 percent decreasers, such as western wheatgrass and side-oats grama, and 50 percent increasers, such as blue grama, buffalograss, sand dropseed, red three-awn, western ragweed, and common pricklypear. Common invaders are little barley, annual brome, and six-weeks fescue.

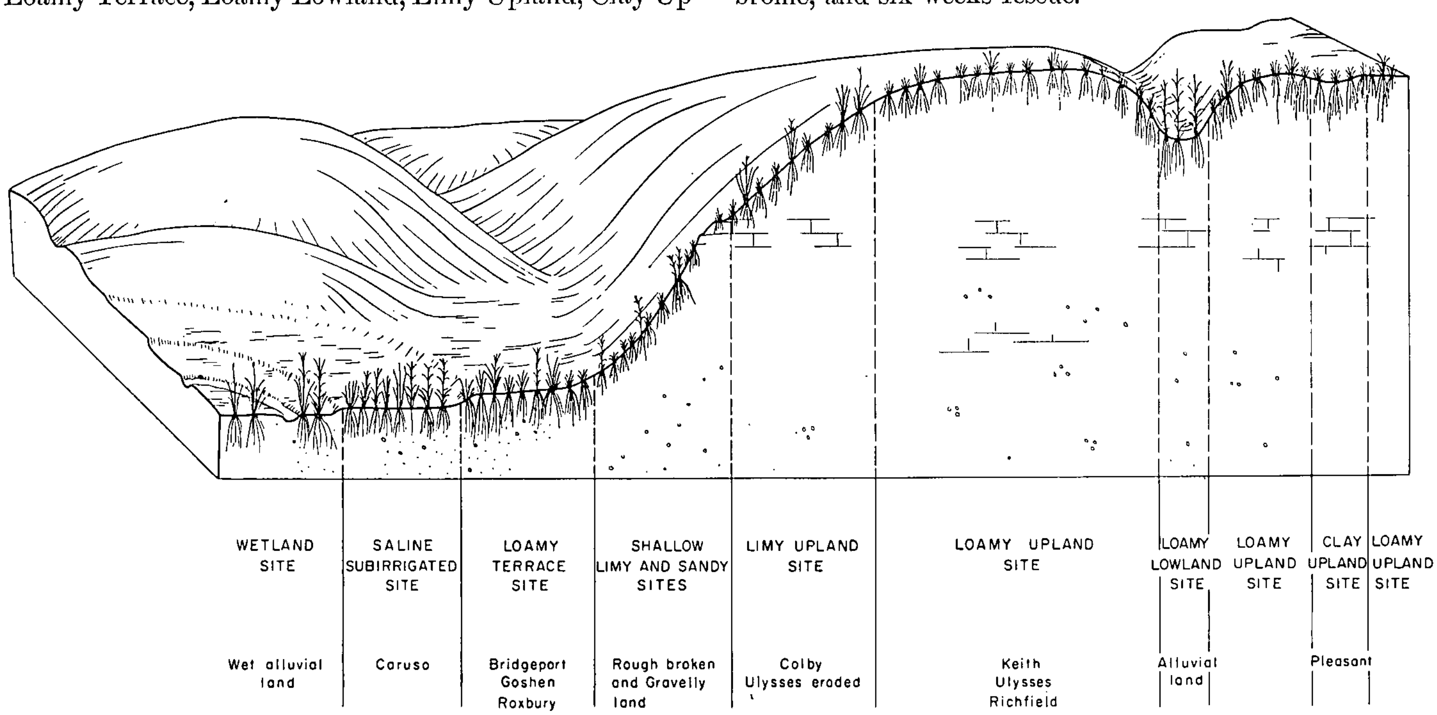

Figure 18.—**Major range sites in Sherman County.**

This site is readily accessible to livestock and is a favorite area for grazing. Continuous overgrazing results in an immediate decrease in side-oats grama and is followed by a decline in western wheatgrass. Buffalograss and blue grama usually carry the grazing load.

The estimated total annual yield per acre of air-dry herbage is 1,800 pounds. Yields range from 2,200 pounds in favorable years to 700 pounds in less favorable years.

LOAMY TERRACE RANGE SITE

This site consists of Slickspots and deep soils of the Bridgeport, Goshen, and Roxbury series. The soils have a surface layer of silt loam and a subsoil of silt loam or silty clay loam. They are on high flood plains, terraces, or fans and in upland swales. They receive some runoff from higher areas. Flooding from streams is infrequent. The soils are moderately permeable to water and roots and have high available water capacity. Fertility is high.

The potential plant community consists mostly of mid and tall grasses. Decreaser grasses, such as switchgrass, big bluestem, little bluestem, side-oats grama, and Canada wildrye, make up about 60 percent of the total annual production. The remaining 40 percent is primarily increasers, such as western wheatgrass, blue grama, and buffalograss. Western ragweed is a common forb increaser. The principal invaders are silver bluestem, annual brome, little barley, windmillgrass, and tumblegrass.

Generally, this site is in fair condition under present grazing use. Blue grama is the main increaser under heavy grazing, except on the Bridgeport-Slickspots complex. Western wheatgrass and blue grama usually carry the grazing load. Inland saltgrass is the main increaser on the Bridgeport-Slickspots complex, and it makes up a large part of the present vegetation. Many of the Slickspots are bare, but some have a thin stand of saltgrass, annual forbs, and annual grasses.

The estimated total annual yield per acre of air-dry herbage is 2,500 pounds. Yields range from 3,000 pounds in favorable years to 1,500 pounds in less favorable years.

LOAMY LOWLAND RANGE SITE

This site consists of Alluvial land and a soil of the Roxbury series. These soils are deep and frequently flooded. The Roxbury soil has a surface layer of silt loam and a subsoil of silt loam to silty clay loam. Alluvial land is sandy loam to light silty clay loam throughout. Both are well drained, are moderately permeable to water and roots, and have moderate to high available water capacity. Fertility is high.

The potential plant community consists mostly of mid and tall grasses. About 70 percent of the total annual production is made up of decreasers, such as big bluestem, switchgrass, little bluestem, and Canada wildrye. The remaining 30 percent is primarily increasers, such as western wheatgrass, blue grama, side-oats grama, buffalograss, and western ragweed. Common invaders are little barley, annual brome, windmillgrass, and tumblegrass.

Generally, this site is in fair condition under present grazing use. Blue grama and western wheatgrass carry the grazing load.

The estimated total annual yield per acre of air-dry herbage is 3,000 pounds. Yields range from 4,000 pounds in favorable years to 2,000 pounds in less favorable years.

LIMY UPLAND RANGE SITE

This site consists of deep soils of the Colby series, eroded soils of the Ulysses series, and the moderately deep to deep, loamy soils in the Rough broken and gravelly land mapping unit. The Colby and Ulysses soils have a surface layer and subsoil of silt loam. They are calcareous at or near the surface. They are moderately permeable to water and roots and have high available water capacity. Fertility is medium to high. Water erosion and soil blowing are hazards in unprotected areas.

The potential plant community consists mostly of mid grasses. About 70 percent of the total production is made up of such decreasers as side-oats grama and little bluestem. The remaining 30 percent is mainly increasers, such as blue grama, hairy grama, buffalograss, red three-awn, sand dropseed, and broom snakeweed. Common invaders are windmillgrass, tumblegrass, little barley, and annual brome.

This site is readily accessible to livestock and is a favorite location for grazing late in spring and in summer. Continuous overuse results in an immediate decrease in little bluestem, followed by a decline in side-oats grama. Generally, blue grama and buffalograss carry the grazing load.

The estimated total annual yield per acre of air-dry herbage is 1,800 pounds. Yields range from 2,400 pounds in favorable years to 800 pounds in less favorable years.

CLAY UPLAND RANGE SITE

Pleasant silty clay loam is the only soil in this site. It is deep and has a silty clay or clay subsoil. This soil receives runoff from surrounding soils and is subject to ponding. It is very slowly permeable to water and has high available water capacity. Fertility is high.

The potential plant community consists mostly of short and mid grasses. About 50 percent of the total annual production is made up of such decreasers as western wheatgrass, side-oats grama, and tall dropseed. The remaining 50 percent is mainly increasers, such as blue grama, buffalograss, silver bluestem, perennial three-awn, sand dropseed, western ragweed, and common pricklypear. The principal invaders are little barley, annual brome, snow-on-the-mountain, windmillgrass, and tumblegrass.

This range site is readily accessible to livestock and is a favorite site for grazing early in spring, in fall, and in winter. Generally, it is in good condition. Side-oats grama is usually the first species to decrease under continuous overuse; a decline in western wheatgrass follows. Blue grama and buffalograss carry the grazing load. This range site varies considerably in the production of forage. If precipitation is high in winter and spring, the production of western wheatgrass is high. If drought prevails during the winter and spring, growth is restricted.

The estimated total annual yield per acre of air-dry herbage is 1,800 pounds. Yields range from 2,200 pounds in favorable years to 1,200 pounds in less favorable years.

SANDY RANGE SITE

This site consists of the coarse-textured, gravelly soils in the mapping unit Rough broken and gravelly land. These soils are excessively drained. They have moderately rapid permeability and low available water capacity. Fertility is low.

About 70 percent of the total annual production consists of such decreasers as sand bluestem, little bluestem, switchgrass, and side-oats grama. Other perennial grasses, forbs, and shrubs make up the rest. The dominant increasers are blue grama, sand dropseed, buffalograss, sand paspalum, and perennial three-awn. Common invaders are windmillgrass, tumblegrass, annual three-awn, and six-weeks fescue.

Generally, this site is in fair condition under present grazing use. Blue grama and sand dropseed carry the grazing load.

The estimated total annual yield per acre of air-dry herbage is 1,800 pounds. Yields range from 2,200 pounds in favorable years to 1,200 pounds in less favorable years.

SHALLOW LIMY RANGE SITE

This site consists of the shallow, loamy soils in the mapping unit Rough broken and gravelly land. These soils are excessively drained. They have moderate permeability and low available water capacity. Fertility is low.

About 70 percent of the total annual production consists of decreasers, such as little bluestem and side-oats grama and a small amount of big bluestem and switchgrass. Other perennial forbs and grasses make up the rest. The principal increasers are hairy grama, blue grama, buffalograss, sand dropseed, purple three-awn, and broom snakeweed. Common invaders are ring muhly, tumblegrass, and annual three-awn.

Generally, this site is in good to excellent condition. Little bluestem and side-oats grama carry the grazing load. Because the topography is rough, this site is not readily accessible to livestock for grazing.

The estimated total annual yield per acre of air-dry herbage is 1,400 pounds. Yields range from 1,600 pounds in favorable years to 800 pounds in less favorable years.

WET LAND RANGE SITE

Wet alluvial land is the only mapping unit in this site. It is on flood plains. The water table is always high; it is seldom below a depth of 3 feet. In winter, early in spring, and during periods of heavy rainfall, free water is at a depth of 18 inches or less. In some places free water is at the surface during these wet periods. The soil material varies, but in most places it is loam or clay loam underlain by gravelly loamy sand at a depth of 18 to 30 inches.

The potential plant community consists of about 90 percent decreasers, such as prairie cordgrass, alkali cordgrass, rice cutgrass, reed canarygrass, American bulrush, Illinois bundleflower, and American licorice. The principal increasers are slim sedge, foxtail barley, knotroot bristlegrass, swamp smartweed, willow, and cattail. Common invaders are barnyardgrass, annual bristlegrass, annual sedges, and annual rushes.

The vegetation on this site is green and lush most all year. This site carries a heavy grazing load. Generally, it is in poor to fair condition. Sedges and swamp smartweed carry the grazing load.

The estimated total annual yield per acre of air-dry herbage is about 7,000 pounds.

SALINE SUBIRRIGATED RANGE SITE

Caruso loam is the only soil in this site. It is a deep, moderately well drained to somewhat poorly drained, slightly to moderately saline soil on flood plains. It is subject to occasional flooding. The water table usually stands at a depth of 4 to 8 feet but rises to within 2 feet of the surface during wet periods.

The potential plant community is about 90 percent decreasers, such as alkali sacaton, switchgrass, indiangrass, side-oats grama, western wheatgrass, Canada wildrye, alkali cordgrass, and Illinois bundleflower. The principal increasers are inland saltgrass, blue grama, foxtail barley, western ragweed, buffalograss, and sedge. Common invaders are silver bluestem, alkali muhly, kochia, and tamarisk.

This range site carries a heavy grazing load because of the water supply, the green vegetation for most of the year, and the level topography. It is usually in fair condition; inland saltgrass furnishes most of the production.

The estimated total annual yield per acre of air-dry herbage is about 6,000 pounds.

Windbreaks

Sherman County has no native forest or large areas of woodland. Small clusters of trees grow on the flood plains of the North Fork of the Smoky Hill River and Beaver Creek but are of minor extent. Trees are planted only for windbreaks or shade or for ornamental purposes because the moisture supply is limited in this county.

Windbreak plantings reduce soil blowing and help protect farmsteads and livestock. They also help make the farmstead more attractive, increase the value of the property, and provide food and cover for wildlife.

Well-planned and well-cared for plantings can be successfully established and maintained (fig. 19). The limited moisture supply is the most critical factor affecting establishment and growth. Competition from other plants can seriously reduce the moisture supply. Areas to be used for windbreaks should be summer fallowed in order to store moisture before planting. Plantings should be of high quality and from seed sources in the same general area. The soil should be tamped firmly around the roots of the seedlings to prevent drying.

After the trees are planted, the area should be cultivated to control weeds between the rows. Weeds can be controlled in the rows by herbicides or hoeing. Irrigation helps insure the survival of trees and increases the rate of growth of newly planted and established windbreaks. Weeds should be controlled by cultivation throughout the life of the windbreak.

Some soils are more favorable for growing trees than others. The Pleasant soils in this county, the Bridgeport-Slickspots complex, Wet alluvial land, and Rough broken and gravelly land are not considered suitable for windbreak plantings.

The soils suitable for windbreak plantings have been grouped into the Upland and the Lowland windbreak suitability groups. The soils in each group are designated by soil series, but this does not mean that all the soils in a given series are in the group. The windbreak suitability group assigned to each soil is listed in the "Guide to Mapping Units" at the back of this survey and at the end of the desecription of that soil in the section "Descriptions of the Soils."

Table 4 lists the trees and shrubs suitable for windbreaks and gives for each windbreak group the estimated maxi-

mum height, growth rate, length of useful life, and suitability of specified trees and shrubs on dryland soils. Irrigation improves all of these factors. Estimates in table 4 are based on information in "Windbreaks for the Central Great Plains" (*6*). Additional information on planning and managing windbreaks can be obtained from a local representative of the Soil Conservation Service or from the county agricultural agent.

Soils in the Upland windbreak suitability group are the deep, medium-textured soils of the Bridgeport, Colby, Keith, Richfield, Roxbury, and Ulysses series. They are on uplands and high terraces. The inadequate moisture supply is the chief limitation.

In the Lowland windbreak group are the deep, medium-textured soils of the Caruso and Goshen series, Alluvial land, and the frequently flooded soils of the Roxbury series. These soils are on flood plains or in swales in the uplands. They receive an extra supply of water during periods of flooding, and in places the water table is high enough to be beneficial to trees.

Fish and Wildlife Management [3]

Many kinds of wildlife live in Sherman County. Pheasant, bobwhite quail, cottontail rabbit, and mourning dove are the main upland game birds and animals. They live in all of the soil associations in the county. Prairie chickens are rarely seen in the county. They are primarily in soil association 2.

A number of abandoned farmsteads in the county provide excellent wildlife habitat (fig. 20).

Scattered, woody areas provide cover and food for mule deer and whitetailed deer that primarily inhabit soil association 2. The number of deer is increasing, although desirable habitat is limited in the county. Only a small number of antelope are in the county. They occupy a small part of the large pasture areas south of the North Fork of the Smoky Hill River in soil association 2.

The main predators in the county are coyote, fox, hawk, owl, and skunk. They are in all of the soil associations in the county. The furbearers include beaver, muskrat, mink, and raccoon. Furbearers associated with aquatic habitats are primarily along Beaver Creek and the North Fork of the Smoky Hill River in soil association 2. Fence rows, odd areas, conservation reserve fields, shelterbelts, and summer-fallowed fields provide the cover and food required by upland game animals. The grain that remains in fields after harvest provides much of the winter food needed by these birds and animals.

Opportunities for fishing are limited in Sherman County. Farm ponds are subject to periodic drying when rainfall is below average. The Sherman County State Lake, about 12 miles southwest of Goodland, impounds water behind a dam constructed across the North Fork of

[3] By JACK W. WALSTROM, biologist, Soil Conservation Service.

Figure 19.—Farmstead windbreak on a Keith silt loam.

the Smoky Hill River. Game fish include bass, bluegill, channel catfish, yellow catfish, and crappie (fig. 21).

Waterfowl are attracted to the basin areas in soil association 3 when water accumulates during wet periods in spring and fall. Grain sorghum can be planted in some of the larger areas when the ground is too wet to plant wheat in the fall. Soil association 3 is characterized by rolling topography and has no defined drainage pattern.

Table 5 shows the potential of the soil associations in the county to provide habitat needed by wildlife.

TABLE 4.—*Trees and shrubs suitable for windbreaks*

Trees and shrubs	Windbreak suitability groups [1]							
	Upland				Lowland			
	Maximum height	Growth rate	Useful life	Suitability	Maximum height	Growth rate	Useful life	Suitability
	Ft.				*Ft.*			
Deciduous trees:								
Boxelder	22	Fast	Short	Good	22	Fast	Short	Good.
Bur oak	31	Slow	Long	Good	40	Slow	Long	Good.
Cottonwood	54	Fast	Short	Not recommended.	70	Fast	Medium	Excellent.
Green ash	31	Medium	Medium	Not recommended.	40	Medium	Medium	Good.
Hackberry	31	Medium	Medium	Excellent	40	Medium	Medium	Excellent.
Mulberry	18	Medium	Short	Good	18	Medium	Medium	Excellent.
Osage-orange	22	Medium	Long	Fair	22	Medium	Long	Good.
Russian-olive [2]	22	Fast	Short	Excellent	22	Fast	Medium	Excellent.
Siberian elm (Chinese). [2]	40	Fast	Medium	Excellent	55	Fast	Medium	Excellent.
Conifers:								
Austrian pine	40	Slow	Medium	Good	50	Slow	Long	Excellent.
Eastern redcedar [2]	32	Slow	Long	Excellent	40	Slow	Long	Excellent.
Ponderosa pine	45	Slow	Long	Good	50	Medium	Medium	Excellent.
Rocky Mountain juniper. [2]	22	Slow	Long	Excellent	22	Slow	Long	Excellent.
Shrubs:								
American plum	9	Fast	Medium	Good	9	Fast	Medium	Excellent.
Aromatic sumac	5	Slow	Medium	Excellent	5	Slow	Medium	Excellent.
Lilac	7	Medium	Medium	Good	7	Medium	Medium	Excellent.
Tamarisk	9	Fast	Short	Excellent	9	Fast	Short	Excellent.
Western chokecherry	9	Fast	Medium	Good	9	Fast	Medium	Excellent.

[1] See descriptions of windbreak suitability groups to determine soil series in each group.
[2] Trees most commonly used for windbreaks in Sherman County.

TABLE 5.—*Potential of soil associations for providing wildlife habitat*

[Absence of entry indicates that potential is not rated]

Soil association	Kinds of wildlife	Potential for producing kinds of habitat			
		Woody	Herbaceous	Aquatic	Food
Association 1.	Openland	Fair	Good		Good.
	Woodland	Poor	Good		Poor.
	Fish			Poor	
Association 2.	Openland	Poor to good	Good	Fair to good	Fair to good.
	Woodland	Poor to good	Good		Poor to good.
	Wetland		Fair	Poor to fair	Poor to good.
	Fish			Poor	
Association 3.	Openland	Fair	Good		Good.
	Woodland	Poor	Good		Poor.
	Wetland		Fair	Fair	Good.
	Fish			Poor	Poor.

Figure 20.—**Typical wildlife habitat adjacent to an abandoned farmstead.**

Openland wildlife are those species that normally inhabit areas of cropland, rangeland, pasture, meadow, and odd areas where shrubs and herbaceous plants grow. Pheasant, quail, cottontail, coyote, badger, and meadowlark are examples.

Woodland wildlife include animals that are generally found in wooded areas or areas intermixed with openland. Examples are deer, squirrel, raccoon, thrushes, and cardinals.

Wetland wildlife normally inhabit wet areas, such as ponds, rivers, streams, swamps, and marshes. Ducks, shore birds, beaver, muskrat, and mink are examples.

The conservation practices that are primarily beneficial to wildlife are habitat development, wetland development, fishpond construction, and habitat preservation. Technical assistance in the planning and application of wildlife developments can be obtained from a representative of the Soil Conservation District in Goodland, Kans. Additional information and assistance can be obtained from the Kansas Forestry, Fish, and Game Commission, the Bureau of Sport Fisheries and Wildlife, and the Kansas State University Extension Service.

Use of the Soils in Engineering[4]

Some soil properties are of special interest to engineers because they affect the design, construction, and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the properties most important to engineers are permeability, strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and soil reaction. Depth to the water table and to bedrock and topography also are important.

Information concerning these and related soil properties is given in tables 6 and 7. No test data are provided in this soil survey. The estimates and interpretations in tables 6 and 7 can be used in—

1. Planning and designing agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.

[4] DANIEL R. DENNELER, civil engineer, Soil Conservation Service, assisted with the preparation of this section.

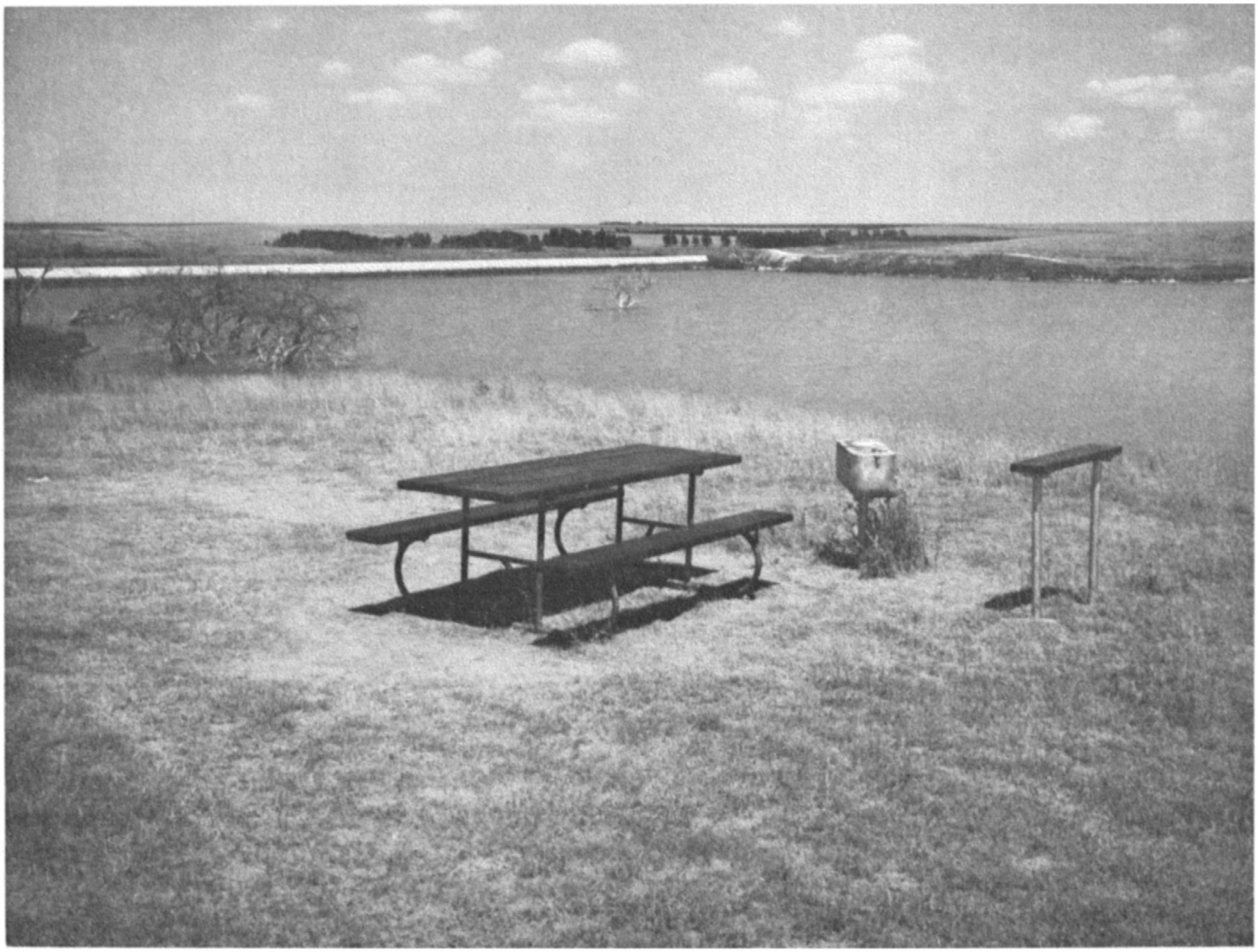

Figure 21.—**Sherman County State Lake and Park and associated recreational facilities.**

2. Selecting sites for highways, airports, pipelines, and cables and in planning detailed investigations at selected locations.
3. Locating probable sources of sand, gravel, and other construction material.
4. Selecting and developing industrial, commercial, residential, and recreational sites.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depths reported. Even in these situations, however, the soil map is useful in planning more detailed field investigations and in indicating the kinds of problems that may be expected.

Some of the terms used by soil scientists have a special meaning in soil science that may not be familiar to engineering. These terms are defined in the Glossary.

Engineering Classification Systems

The two systems most commonly used in classifying soils for engineering are the system approved by the American Association of State Highway Officials (AASHO) and the Unified system.

The AASHO system (*1*) is used to classify soils according to those properties that affect use in highway construction. In this system all soil material is classified in seven principal groups on the basis of grain-size distribution, liquid limit, and plasticity index. The groups range from A–1, which consists of soils that have the highest bearing strength and are the best soils for road fill, to A–7, which consists of soils that have the lowest strength when wet. Soils that are near the borderline between two classes are designated by symbols for both classes, for example, A–4 or A–6.

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TABLE 6.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Depth from surface	Classification		
		Dominant USDA texture	Unified	AASHO
	In.			
Alluvial land: Ad. No valid estimates can be made.				
*Bridgeport: Bd, Be, Bs. For Slickspots part of unit Bs, refer to Slickspots.	0–60	Silt loam	ML–CL or CL	A–4 or A–6
Caruso: Ca	0–60	Loam	ML or ML–CL	A–4
*Colby: Cb, Cu. For Ulysses part of unit Cu, refer to Ulysses series.	0–60	Silt loam	ML or ML–CL	A–4
Goshen: Go	0–22	Silt loam	ML or ML–CL	A–4 or A–6
	22–40	Silty clay loam	CL	A–7
	40–60	Silt loam	ML or ML–CL	A–4 or A–6
*Keith: Ke, Kh, Ku. For Ulysses part of unit Ku, refer to Ulysses series.	0–6	Silt loam	ML or ML–CL	A–4 or A–6
	6–14	Silty clay loam	CL	A–6 or A–7
	14–20	Silt loam	CL	A–6 or A–7
	20–60	Silt loam	ML–CL or ML	A–4 or A–6
Pleasant: Pe	0–16	Silty clay loam	CL	A–6 or A–7
	16–60	Silty clay	CH	A–7
Richfield: Rc	0–4	Silt loam	ML–CL or CL	A–4 or A–6
	4–15	Silty clay loam	CL	A–7
	15–60	Silt loam	ML or ML–CL	A–4 or A–6
Rough broken and gravelly land: Rh. No valid estimates can be made.				
Roxbury: Ro, Rx	0–12	Silt loam	ML or ML–CL	A–4 or A–6
	12–28	Silty clay loam	ML–CL or CL	A–6 or A–7
	28–60	Silt loam	ML or ML–CL	A–4 or A–6
Slickspots. Mapped only with Bridgeport soils.	0–4	Silt loam	ML	A–4
	4–9	Silty clay	CL or CH	A–7
	9–18	Silty clay loam	CL	A–7
	18–60	Silty clay loam	ML–CL or CL	A–6 or A–7
*Ulysses: Ua, Ub, Uc, Ud, Uk. For Colby part of unit Ud, refer to Colby series. For Keith part of unit Uk, refer to Keith series.	0–5	Silt loam	ML or ML–CL	A–4 or A–6
	5–60	Silt loam	ML or ML–CL	A–4 or A–6
Wet alluvial land: Wa. No valid estimates can be made.				

significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
				In./hr.	*In./in. of soil*	*pH*	
95–100	95–100	85–95	70–90	0. 63–2. 00	0. 16–0. 18	7. 9–8. 4	Low.
90–100	90–100	80–90	60–75	0. 63–2. 00	0. 15–0. 17	7. 9–8. 4	Low.
100	100	90–100	75–100	0. 63–2. 00	0. 16–0. 18	7. 4–8. 4	Low.
100	100	90–100	75–90	0. 63–2. 00	0. 18–0. 20	6. 6–7. 3	Low.
100	100	90–100	75–90	0. 63–2. 00	0. 16–0. 18	6. 6–8. 4	Moderate.
100	100	90–100	75–90	0. 63–2. 00	0. 16–0. 18	7. 9–8. 4	Low.
100	100	100	85–100	0. 63–2. 00	0. 18–0. 20	6. 6–7. 3	Low.
100	100	100	90–100	0. 63–2. 00	0. 16–0. 18	6. 6–7. 3	Moderate.
100	100	100	90–100	0. 63–2. 00	0. 16–0. 18	7. 4–7. 8	Low.
100	100	100	85–100	0. 63–2. 00	0. 16–0. 18	7. 9–8. 4	Low.
100	100	90–100	90–100	0. 06–0. 20	0. 16–0. 18	7. 4–8. 4	Moderate.
100	100	90–100	90–100	<0. 06	0. 15–0. 17	7. 9–8. 4	High.
100	100	100	85–100	0. 63–2. 00	0. 18–0. 20	6. 6–7. 3	Low.
100	100	100	90–100	0. 20–0. 63	0. 16–0. 18	6. 6–7. 3	Moderate.
100	100	100	85–100	0. 63–2. 00	0. 16–0. 18	7. 9–8. 4	Low.
100	100	90–100	75–90	0. 63–2. 00	0. 17–0. 19	6. 6–7. 3	Low.
100	100	90–100	75–90	0. 63–2. 00	0. 17–0. 19	7. 9–8. 4	Low.
100	100	90–100	75–90	0. 63–2. 00	0. 17–0. 19	7. 9–8. 4	Low.
95–100	95–100	85–95	70–90	0. 63–2. 00	0. 17–0. 18	6. 1–6. 5	Low.
95–100	95–100	85–95	80–95	<0. 06	0. 14–0. 16	7. 9–8. 4	High.
95–100	95–100	85–95	80–95	0. 20–0. 63	0. 16–0. 18	7. 9–8. 4	Moderate.
95–100	95–100	85–95	70–90	0. 63–2. 00	0. 16–0. 18	7. 9–8. 4	Low.
100	100	90–100	75–100	0. 63–2. 00	0. 16–0. 18	6. 6–8. 4	Low.
100	100	90–100	75–100	0. 63–2. 00	0. 16–0. 18	7. 4–8. 4	Low.

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soils. The soils in for referring to other series that

Soil series and map symbols	Suitability as source of—				Soil features affecting—		
	Topsoil	Sand and gravel	Road fill		Highway location [1]	Dikes and levees	Farm ponds
			Embankment [1]	Subgrade [1]			Reservoir area
Alluvial land: Ad. No interpretations; properties too variable.							
*Bridgeport: Bd, Be, Bs. For Slickspots part of unit Bs, refer to Slickspots.	Good	Poor: deep overburden in areas of sand.	Good	Fair	Moderate erodibility; minor flooding.	Fair stability; moderate piping hazard.	Deep; moderate permeability; 0 to 4 percent slopes.
Caruso: Ca	Good	Poor: deep overburden; fluctuating water table.	Good	Fair except for pockets of sand and gravel; sand and gravel may need to be confined, mixed, or stabilized.	Fluctuating water table; occasional flooding; moderately susceptible to frost heaving.	Fair to poor stability; moderate piping hazard.	Deep; moderate permeability; fluctuating water table; 0 to 1 percent slopes.
*Colby: Cb, Cu. For Ulysses part of unit Cu, refer to Ulysses series.	Fair to good; erodible on steep slopes.	Poor: some pockets of sand and gravel are in steep areas.	Good	Good	Good drainage; moderate erodibility; 1 to 15 percent slopes; fair to poor stability; susceptible to frost heaving.	Fair to poor stability; fair compaction; moderate erodibility.	Deep; moderate permeability; stream channels contain rapidly permeable sand in places; 1 to 15 percent slopes.
Goshen: Go	Good	Not suitable.	Good	Fair	Good drainage; minor flooding and deposition; fair to good stability; susceptible to frost heaving.	Fair to good stability and compaction; moderate erodibility; moderate shrink-swell potential in subsoil.	Deep; moderate permeability; 0 to 1 percent slopes.

See footnote at end of table.

interpretations of soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

Soil features affecting—Continued						Soil limitations for sewage disposal	
Farm ponds—Con. Embankment	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Fair stability and compaction; moderate piping hazard; moderate erodibility.	Moderate permeability; minor flooding.	Deep; good drainage; moderate permeability; high available water capacity; minor flooding; 0 to 4 percent slopes.	Fair stability; moderate permeability; 0 to 4 percent slopes; short slopes.	Moderate erodibility; good drainage; 0 to 4 percent slopes.	Fair stability; medium compressibility.	Moderate: moderate permeability; minor flooding.	Moderate: moderate permeability; minor flooding.
Fair to poor stability and compaction; moderate piping hazard; moderate erodibility.	Moderate permeability; fluctuating water table; occasional flooding.	Moderate to somewhat poor drainage; fluctuating water table; high available water capacity; occasional flooding; 0 to 1 percent slopes.	Fair to poor stability; moderate permeability; 0 to 1 percent slopes; on flood plain.	Moderate erodibility; fluctuating water table; slight to moderate salinity; 0 to 1 percent slopes; on flood plain.	Fair to poor stability; medium compressibility; fluctuating water table; occasional flooding.	Severe: fluctuating water table; occasional flooding.	Severe: fluctuating water table; occasional flooding.
Fair to poor stability; fair compaction; moderate erodibility.	Good drainage; moderate permeability.	Deep; 1 to 15 percent slopes; moderate permeability; high available water capacity.	Fair to poor stability; moderate permeability; 1 to 15 percent slopes.	Moderate erodibility; good drainage; 1 to 15 percent slopes.	Fair to poor stability; medium compressibility.	Moderate to severe: moderate permeability; 1 to 15 percent slopes.	Moderate to severe: moderate permeability; 1 to 15 percent slopes.
Fair to good stability and compaction; moderate erodibility; moderate shrink-swell potential in subsoil.	Good drainage; moderate permeability; minor flooding.	Deep; 0 to 1 percent slopes; moderate permeability; high available water capacity; minor flooding.	Fair to good stability; moderate permeability; 0 to 1 percent slopes.	Moderate erodibility; minor flooding and deposition; good drainage; 0 to 1 percent slopes.	Fair to good stability; medium compressibility; moderate shrink-swell potential in subsoil; moderate permeability.	Moderate to severe: moderate permeability; minor flooding.	Moderate to severe: moderate permeability; minor flooding.

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TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—				Soil features affecting—		
	Topsoil	Sand and gravel	Road fill		Highway location [1]	Dikes and levees	Farm ponds
			Embankment [1]	Subgrade [1]			Reservoir area
*Keith: Ke, Kh, Ku. For Ulysses part of unit Ku, refer to Ulysses series.	Good	Not suitable.	Good	Fair	Good drainage; susceptible to frost heaving; fair to good stability.	Fair to good stability; moderate erodibility; moderate shrink-swell potential in subsoil.	Deep; moderate permeability; 0 to 3 percent slopes.
Pleasant: Pe	Poor; high clay content.	Not suitable.	Poor	Poor	Ponded after a rain; susceptible to frost heaving; fair to good stability and compaction in top 16 inches, fair to poor stability and compaction in subsoil; high compressibility.	Fair to poor stability and compaction in subsoil; high compressibility; high shrink-swell potential; high plasticity.	Deep; very slow permeability; naturally ponded in depressed areas; moderately slow permeability in substratum; 0 to 2 percent slopes.
Richfield: Rc	Good	Not suitable.	Fair to good.	Poor to fair.	Good drainage; susceptible to frost heaving; fair to good stability.	Fair to good stability; moderate erodibility; moderate shrink-swell potential in subsoil.	Deep; moderately slow permeability; 0 to 1 percent slopes.
Rough broken and gravelly land: Rh. No interpretations; properties too variable.							
Roxbury: Ro, Rx	Good	Not suitable.	Good	Fair	Subject to flooding.	Fair stability and compaction; moderate erodibility.	Deep; moderate permeability; 0 to 2 percent slopes.

See footnote at end of table.

interpretations of soils—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Farm ponds—Con.	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Embankment							
Fair to good stability and compaction; moderate erodibility; moderate shrink-swell potential in subsoil.	Good drainage; moderate permeability.	Deep; 0 to 3 percent slopes; moderate permeability; high available water capacity.	Fair to good stability; moderate permeability; 0 to 3 percent slopes.	Moderate erodibility; good drainage; 0 to 3 percent slopes.	Fair to good stability; medium compressibility; moderate shrink-swell potential in subsoil.	Moderate: moderate permeability.	Moderate: moderate permeability; 0 to 3 percent slopes.
Fair to good stability and compaction in top 16 inches; fair to poor stability and compaction in subsoil; high compressibility; high shrink-swell potential; high plasticity.	Ponded after a rain; very slow permeability; depressed areas without surface drainage.	Deep; ponded after a rain; very slow permeability; depressed areas without surface drainage; high available water capacity; 0 to 2 percent slopes.	Ponded after a rain; very slow permeability; depressed areas without surface drainage; 0 to 2 percent slopes.	Ponded after a rain; very slow permeability; depressed areas without surface drainage; 0 to 2 percent slopes.	Ponded after a rain; very slow permeability; high compressibility; high shrink-swell potential; high plasticity; fair to poor stability in subsoil.	Severe: very slow permeability; ponded after a rain.	Moderate: surface runoff must be kept out of lagoons; very slow permeability; depressed areas without surface drainage.
Fair to good stability and compaction; moderate shrink-swell potential in subsoil; moderate erodibility.	Good drainage; moderately slow permeability.	Deep; 0 to 1 percent slopes; moderately slow permeability; high available water capacity.	Fair to good stability; moderately slow permeability; 0 to 1 percent slopes.	Moderate erodibility; good drainage; 0 to 1 percent slopes.	Fair to good stability; medium compressibility; moderate shrink-swell potential in subsoil; moderately slow permeability.	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.
Fair stability and compaction; moderate erodibility.	Good drainage; moderate permeability; subject to flooding.	Deep; 0 to 2 percent slopes; moderate permeability; high available water capacity; subject to flooding.	Fair stability; moderate permeability; 0 to 2 percent slopes.	Moderate erodibility; subject to flooding; good drainage; 0 to 2 percent slopes.	Fair stability; medium compressibility; subject to flooding.	Severe: moderate permeability; subject to flooding.	Moderate to severe: moderate permeability; subject to flooding.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of— Topsoil	Sand and gravel	Road fill: Embankment [1]	Road fill: Subgrade [1]	Soil features affecting— Highway location [1]	Dikes and levees	Farm ponds: Reservoir area
Slickspots. Mapped only with Bridgeport soils.	Poor; high clay content.	Poor; deep overburden in areas of sand.	Not suitable.	Not suitable.	Moderate erodibility; minor flooding; moderate to high shrink-swell potential in subsoil.	Fair stability; moderate to high shrink-swell potential in subsoil.	Deep; very slow permeability; 0 to 1 percent slopes.
*Ulysses: Ua, Ub, Uc, Ud, Uk. For Colby part of unit Ud, refer to Colby series. For Keith part of unit Uk, refer to Keith series.	Good	Not suitable	Good	Fair	0 to 10 percent slopes; good drainage; moderate erodibility; fair to poor stability; susceptible to frost heaving.	Fair to poor stability; fair compaction; moderate erodibility.	Deep; moderate permeability; 0 to 10 percent slopes.
Wet alluvial land: Wa. No interpretations; properties too variable.							

[1] Estimates were made with the assistance of JOHN E. HUFFMAN, engineer of soils, and HERBERT E. WORLEY, soils research engineer'

In the Unified system (*11*) soils are classified according to their particle-size distribution, plasticity, and liquid limit. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. GP and GW are clean gravels, and GM and GC are gravels that include, respectively, an appreciable amount of nonplastic and plastic fines. SP and SW are clean sands. SM and SC are sands that include fines of silt and clay. ML and CL are silts and clays that have a low liquid limit, and MH and CH are silts and clays that have a high liquid limit. Soils on the borderline between two classes are designated by symbols for both classes, for example, ML–CL.

Soil scientists use the USDA textural classification (*9*). In this, the texture of the soil is determined according to the proportion of soil particles smaller than 2 millimeters in diameter, that is, the proportion of sand, silt, and clay. Textural modifiers, such as gravelly, are used as needed.

Table 6 shows the estimated classification of all the soils in Sherman County according to all three systems of classification.

Soil Properties Significant in Engineering

Table 6 gives estimates of soil properties important to engineering. The estimates are based on field classification and descriptions, on test data from comparable soils in adjacent areas, and from experience working with the individual kind of soil in the survey area. The information is generalized for a soil. It is the best available estimate of the specific soil properties. A soil designated by a given name varies somewhat from place to place so that there might be some variance from the properties listed. In addition, some mapping units contain small spots of contrasting soils.

Table 6 gives the classification according to the textural classes of the U.S. Department of Agriculture and the estimated AASHO and Unified classifications.

Permeability as used in table 6 relates only to the movement of water downward through undisturbed and noncompacted soil. It does not include lateral seepage. The estimates are based on the structure and the porosity of the soils. Plowpans, surface crusts, and other properties that result from using the soils are not considered.

Available water capacity (also termed available moisture capacity), commonly expressed as inches of water per inch of soil, is the capacity of soils to hold water available for use by most plants. It is the difference between the amount of soil water at field capacity and the amount at wilting point.

Reaction, or pH, is the degree of acidity or alkalinity of a soil.

Shrink-swell potential indicates the volume change to be expected in soil material as a result of change in mois-

interpretations of soils—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Farm ponds—Con.	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Embankment							
Fair stability and compaction; moderate to high shrink-swell potential in subsoil; moderate erodibility.	Very slow permeability; minor flooding.	Deep; very slow permeability; minor flooding; salinity in substratum; high available water capacity; surface ponding; 0 to 1 percent slopes.	Fair stability; very slow permeability; 0 to 1 percent slopes.	Moderate erodibility; salinity in substratum; low fertility; 0 to 1 percent slopes.	Fair stability; medium compressibility; medium to high shrink-swell potential in subsoil; very slow permeability.	Severe: very slow permeability; minor flooding.	Moderate: very slow permeability; minor flooding.
Fair to poor stability; fair compaction; moderate erodibility.	Good drainage; moderate permeability.	Deep; 0 to 10 percent slopes; moderate permeability; high available water capacity.	Fair to poor stability; moderate permeability; 0 to 10 percent slopes.	Moderate erodibility; good drainage; 0 to 10 percent slopes.	Fair stability; medium compressibility.	Moderate to severe; moderate permeability; 0 to 10 percent slopes.	Moderate to severe; moderate permeability; 0 to 10 percent slopes.

Kansas State Highway Commission.

ture content. The shrinking and swelling of soils damage building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Not given in tables 6 and 7 are the depth to bedrock and the water table, the hazard of flooding, and the salinity and corrosivity of the soils.

Most soils in Sherman County are deep enough over bedrock that bedrock does not affect their use. Caliche, however, is within a few inches of the surface in some areas of Rough broken and gravelly land.

Ground water is many feet below the surface in most soils in Sherman County. In Caruso soils, however, the water table is usually at a depth of 4 to 8 feet, but it rises to within 2 feet of the surface during wet periods. In Wet alluvial land the water table is seldom more than 3 feet below the surface. In winter, early in spring, and during periods of heavy rainfall free water generally is at a depth of 18 inches or less and is at the surface in some places.

The hazard of flooding is not given in table 6. Bridgeport, Caruso, and Roxbury soils, the Bridgeport-Slickspots complex, Alluvial land, and Wet alluvial land are subject to flooding. Pleasant soils are subject to ponding. The other soils in the county are not subject to flooding or ponding.

Salinity is based on the electrical conductivity of the saturated soil extract, as expressed in millimhos per centimeter at 25 C. It affects the suitability of a soil for crops, its stability when used for construction material, and its corrosiveness to other materials. Only three soils in Sherman County are affected by salinity. Caruso loam and Wet alluvial land are slightly to moderately saline, and Slickspots are moderately saline.

Ratings for corrosivity are not given in table 6. Corrosivity indicates the potential danger to uncoated metal or concrete structures through chemical action that dissolves or weakens the structural material. Structural material may corrode when buried in soil, and a given material corrodes in some kinds of soil more rapidly than in other kinds. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations that are entirely in one kind of soil or soil horizon.

Most of the soils in Sherman County are low in corrosivity to both concrete and steel. Pleasant soils are moderately corrosive to steel because they are fine textured and are ponded after a rain. Wet alluvial land and the Caruso soils may cause corrosion of either concrete or steel because they have a high water table and contain salts. Slickspots have the highest concentration of salts and are probably the most corrosive soils in the county.

Engineering Interpretations of Soils

In table 7 the soils are rated according to suitability as sources of topsoil, sand and gravel, and road fill and ac-

cording to the degree and kinds of limitations when used as septic tank filter fields and sewage lagoons. The table also shows soil features that affect the location of highways and use of the soils in engineering structures and practices. The ratings and interpretations given in the table are based on the estimates of soil properties given in table 6 and on observations of soils in the field.

Topsoil.—Topsoil is fertile soil material, ordinarily rich in organic matter, that is used to topdress lawns, gardens, slopes, roadbanks, and other places where vegetation is to be established and maintained.

Sand and gravel.—The ratings given in table 7 are based on the suitability of the soils as a source of sand and gravel. They do not indicate the quality or extent of the deposits.

Road fill.—Soil is rated according to its performance if excavated and used for embankments and as fill for road subgrade.

Highway location.—The soil features affecting highway location are for soils in place. The entire soil profile is evaluated for undisturbed soil that has not been drained but has had the organic surface layer removed.

Dikes and levees.—The suitability of soils for dikes and levees depends on the predicted behavior of soil material if excavated and used for low embankments.

Farm ponds.—The reservoir areas of farm ponds are affected by the seepage rate of water through undisturbed soil of impoundment areas. The soil features considered include permeability, the slope, and the height and fluctuation of the water table. For embankments, the subsoil and the underlying material were considered where they have significant thickness. Among the features that affect the suitability of soil material for embankments are stability and compaction, shrink-swell potential, and erodibility.

Agricultural drainage.—The features and qualities of soil that affect the installation and performance of surface and subsurface drainage systems include permeability, the susceptibility to flooding, and a fluctuating water table.

Irrigation.—Features that affect irrigation include the degree of natural drainage, permeability, available water capacity, susceptibility to flooding, and the slope.

Terraces and diversions.—Soil features and qualities that affect stability or hinder layout and construction are considered when determining the suitability of a soil for terraces and diversions. Sedimentation in channels and the difficulty of establishing and maintaining a plant cover are also concerns.

Grassed waterways.—The features that influence the design of waterways and the kinds of grasses used for sodding the waterways are the erodibility and salinity of the soil, the degree of natural drainage, the slope, susceptibility to flooding, and the height and fluctuation of the water table.

Foundations for low buildings.—The features shown in table 7 that affect the use of soils as foundations for low buildings are those for undisturbed soils to a depth of approximately 5 feet. They affect the suitability of the soil to support buildings that have normal foundation loads. Among the features are stability and compressibility of the soil material, the height and fluctuation of the water table, susceptibility to flooding, shrink-swell potential, and permeability.

Septic tank filter fields.—The ratings given in table 7 for disposing of effluent from septic tanks are for undisturbed soil. Among the features considered are those that limit the absorption of effluent. The features that affect the degree of limitation are permeability, susceptibility to flooding, the height of a fluctuating water table, and the slope.

Sewage lagoons.—The ratings for sewage lagoons are for the ability of undisturbed soil to hold sewage for the time required for bacterial decomposition. Among the features that affect the degree of limitation are permeability, the susceptibility to flooding, the height of a fluctuating water table, and the slope.

Formation and Classification of the Soils

This part of the survey tells how the factors of soil formation have affected the development of soils in Sherman County. It also explains the system of soil classification currently used and classifies each series in the county according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil development have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effect on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated material from which the soil develops. The parent material for the soils of Sherman County are loess, plains outwash, alluvium, and colluvium.

Most of the soils of the county formed from loess. Keith, Ulysses, and Colby are the main soils formed from loess. The loess is calcareous, porous, and more than 50 percent silt. It was deposited by strong winds in late Pleistocene time. The loess in this county is as much as 50 feet thick over sand, gravel, silt, and clay of the Ogallala Formation. Along the larger streams the loess has been partly removed

by erosion. The divides have a loess cap that has been thinned, or is absent, on the side slopes of the drainageways. In some places the Ogallala Formation is exposed (fig. 22) (*5*).

The plains outwash, or Ogallala Formation, consists of sand, gravel, silt, and clay, some of which is partly cemented with lime. This material was deposited by shifting streams that originated in the Rocky Mountains during Pliocene time. The Ogallala Formation is the parent material of Rough broken and gravelly land and is one of the sources of the alluvial and colluvial deposits in the county.

The alluvium in this county, consisting of mixtures of sand, gravel, silt, and clay, was recently deposited by water in the stream valleys. This material was eroded from loess and from the Ogallala Formation and was redeposited in the stream valleys. The soils that formed in alluvium in Sherman County are mostly medium textured, but they have thin strata of coarser material in some places, and in many places they are underlain by sand and gravel. Loess deposits are the main sources of the medium-textured alluvium. The coarse material, sand and gravel, is from the Ogallala Formation.

The colluvial material in the county is similar to the alluvial material, but it has moved a shorter distance. The colluvium is at the base of the slopes from which it eroded.

Climate

Sherman County has a continental, semiarid climate. The average annual precipitation is about 17 inches, but ranges from about 10 to 30 inches. A large part of the moisture falls during the growing season. In summer the days are hot and the nights are generally cool; sunshine is abundant. Moderate to strong winds and low humidity produce a high rate of evaporation. Winters are usually moderate, and there is relatively little snow.

The effects of climate on the soils of the county vary with the kind of parent material, the relief, and the length of time it has had to act on the parent material. None of the soils have been excessively leached of plant nutrients, and some have free lime in the surface layer. Except for some young soils that formed in alluvium, most of the soils have an accumulation of lime within 30 inches of the surface.

Keith soils are an example of the influence of climate on the formation of soils in the county. They are in smooth, gently sloping areas where the surface drainage is neither restricted nor excessive. These soils formed in pale-brown, calcareous loess that is about 18 to 22 percent clay and is high in weatherable minerals. They are mature soils that have a well developed profile. Because of weathering and leaching, they have a horizon of clay accumulation about 10 to 20 inches thick; this horizon is about 30 to 35 percent clay. Keith soils are leached of free carbonates to a depth of 14 to 30 inches; below 30 inches they have been little affected by climate except for some accumulation of lime.

Volume changes caused by freezing, thawing, and alternate periods of wet and dry weather have also influenced the structure of the upper horizons of the soils in this county.

Plant and animal life

Plants and animals are important in soil formation, mainly because of their effect on horizon development. The kinds of plants growing on and in the soil determine the kind and amount of organic matter in the soil.

All of the soils of Sherman County formed under grass. Grasses have a fibrous root system. In native grassland the upper few inches of soil material contains a large number of fine roots. Decomposed organic matter has darkened

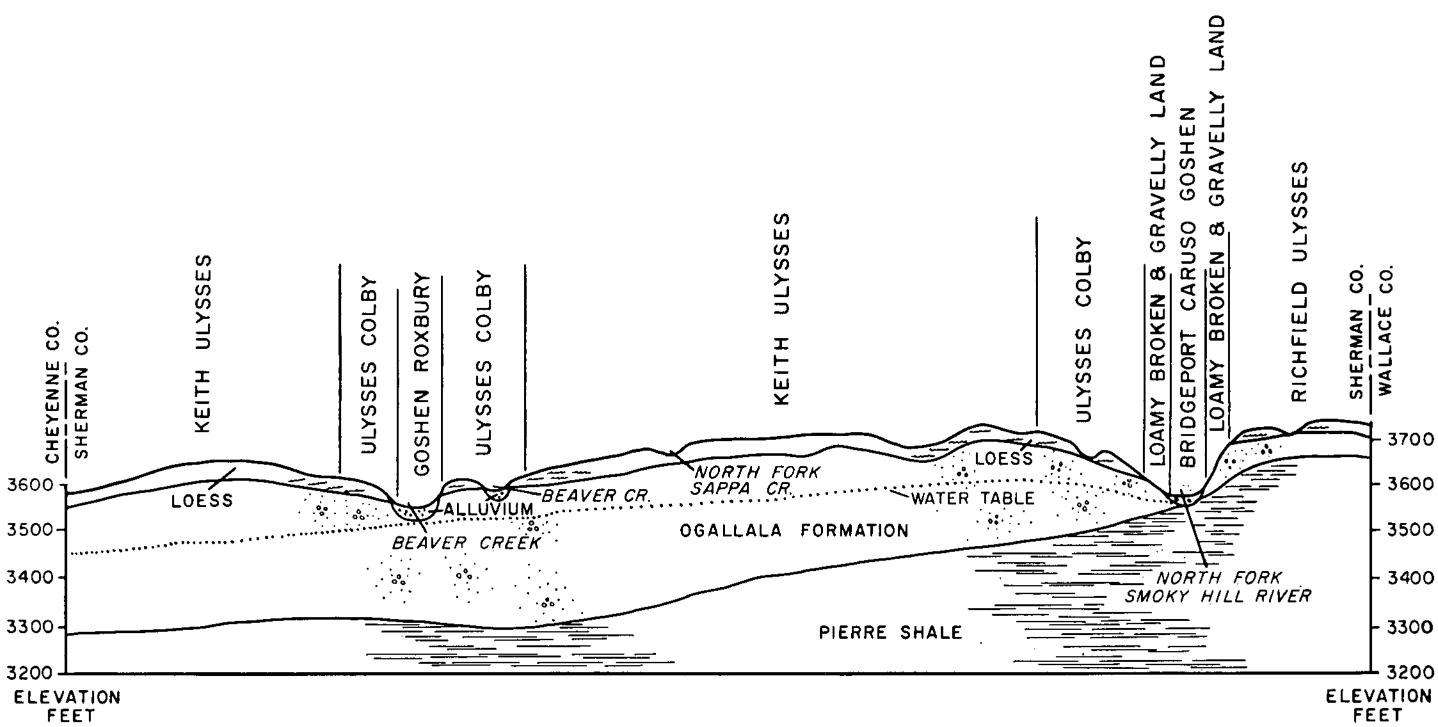

Figure 22.—A cross section of Sherman County soils extending through the center of the county.

the upper part of the soil and has influenced the development of soil structure. Plant growth and the accumulation of organic matter are greatest in the nearly level areas. As a result the nearly level soils, such as Keith, are darkened by organic matter to a greater depth than the more sloping soils, such as Colby.

Micro-organisms in the soil live mainly on the remains of the higher plants and animals. They break down the complex organic material into simpler forms. The simpler compounds supply needed nutrients for the higher plants and also help to form and stabilize the structural peds.

Earthworms and larger burrowing animals influence soil formation by mixing the soil material. Many worm casts are in the upper layers of most of the soils in the county. Burrows of larger animals are seen as holes or as areas of contrasting color where the holes have been filled.

Relief

Relief affects runoff, erosion, and drainage. If the other factors of soil formation are constant, an increase in slope causes increased runoff, increased erosion, and slower profile development. Soils that receive extra moisture as runoff from other soils are the most strongly developed.

Keith, Ulysses, and Pleasant soils are examples of soils affected by relief. These soils have similar parent material. The differences in profile characteristics are primarily the result of the difference in relief.

Keith soils are smooth and gently sloping; drainage is neither restricted or excessive on this soil. Ulysses soils are in the more sloping, weakly convex areas, and they have a higher rate of runoff and erosion than Keith soils. Pleasant soils are in shallow, undrained depressions, and they receive runoff from adjacent areas. Keith soils are less clayey and better drained than Pleasant soils. They are dark colored and are leached of lime to a greater depth than Ulysses soils.

Time

Time is necessary for soils to develop from parent material. The length of time needed for a soil with distinct horizons to develop depends on the other factors of soil formation. For example, Keith and Ulysses soils formed in similar parent material; Keith soils have more distinct horizons than Ulysses soils because they are on smoother slopes on which runoff and erosion are less. Caruso soils formed in alluvium of recent age and have weakly developed soil horizons.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experiences and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*8*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*7*) and was adopted in 1965 (*10*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of Sherman County by family, subgroup, and order, according to the current system.

ORDER: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions are Entisols and Histosols, both of which occur in many different kinds of climate. Two soil orders are represented in Sherman County: Entisols and Mollisols.

Entisols are light-colored soils that do not have natural genetic horizons or that have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect soil mixing caused by shrinking and swelling.

Mollisols formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. The soil material in these soils has not been mixed by shrinking and swelling.

SUBORDER: Each order is divided into suborders, primarily on the basis of soil characteristics that seem to pro-

TABLE 8.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Bridgeport	Fine-silty, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Caruso	Fine-loamy, mixed, mesic	Aquic Fluventic Haplustolls	Mollisols.
Colby	Fine-silty, mixed, calcareous, mesic	Ustic Torriorthents	Entisols.
Goshen	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Keith	Fine-silty, mixed, mesic	Aridic Argiustolls	Mollisols.
Pleasant	Fine, montmorillonitic, mesic	Aridic Pachic Argiustolls	Mollisols.
Richfield	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Roxbury	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Ulysses	Fine-silty, mixed, mesic	Aridic Haplustolls	Mollisols.

duce classes having the greatest genetic similarity. A suborder has a narrower climatic range than an order. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or those that reflect differences in climate or vegetation. The suborders are not shown separately in table 8, because they are identified by the last part of the second word in the name of the subgroup.

GREAT GROUP: Each suborder is divided into great groups on the basis of similarity in kind and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those in which a pan interferes with the growth of roots or movement of water. Among the features considered are the self-mulching properties of clay, the soil temperature, and the major differences in chemical composition. The great groups are not shown separately in table 8, because they are identified by the last word in the name of the subgroup.

SUBGROUP: Each great group is divided into subgroups, one representing the central, or typic, segment of the group, and others, called intergrades, representing the soils that have mostly the properties of one great group but also have one or more properties of another great group, suborder, or order. Subgroups may also be established in those instances where soil properties intergrade outside the range of any recognized great group, suborder, or order.

FAMILY: Each subgroup is divided into families on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

A description of each soil mapped in the county can be found in the section "Descriptions of the Soils."

Additional Facts About the County

Sherman County, named after Gen. William T. Sherman, was organized in 1873. Goodland, the present county seat, was established in 1887.

The population of Sherman County was 5,220 in 1890. It has fluctuated from a low of 3,307 in 1900 to 6,682 in 1960. The population of Goodland was 4,459 in 1962 and 5,600 in January 1967.

Climate [5]

Sherman County, in northwestern Kansas, has a semiarid, continental climate characterized by low annual precipitation, dry air, warm to hot summers, cold winters, moderate to strong surface winds, and wide daily and annual variations in temperature. The average elevation is 3,700 feet above sea level.

Except for low precipitation in most growing seasons, the climate is suitable for a variety of crops. Temperature and precipitation data are shown in table 9.

The Gulf of Mexico is the principal source of moisture for Kansas (*4*), but the greater frequency of the flow of moist air from the Gulf over eastern Kansas and the rain shadow effect of the Rocky Mountains both contribute to a wide range in precipitation across the State. Annual precipitation ranges from 16 inches along the Colorado border of southwestern Kansas to 41 inches in the extreme southeastern corner. Thus, Sherman County, with an average of 17 inches, is in one of the driest areas in Kansas.

Significant to farming in the county is that a large part of the moisture falls during the growing season. More than three-fourths of the annual precipitation falls during the period April through September. Rainfall is heaviest in June; it averages nearly 3 inches in that month. Winters are usually dry. Precipitation averages less than one-half inch in each of the months from December through February.

Even though the bulk of the precipitation falls during the growing season, lack of moisture is the most frequent limiting factor in crop production on dryland farms in the county. Moderate winds, high temperatures, and low humidity in summer produce evapotranspiration rates that are considerably more than rainfall. Fallowing of land helps to conserve moisture and is a common practice.

Showers and thundershowers account for most of the precipitation in Sherman County. Some thunderstorms produce heavy and dashing rains that wash out newly seeded crops and cause considerable erosion in cultivated fields. Damaging hailstorms are more frequent in Sherman County than in counties farther to the east in Kansas. The most damaging storms occur in May and June, but hailstorms in any one year damage only a small area.

Rainfall is variable from year to year. During the period 1907 to 1966 the annual precipitation at Goodland ranged from 30.89 inches in 1915 to 9.19 inches in 1956. It is not uncommon for a series of dry years to occur. Droughts were especially severe during the 1930's and from 1952 to 1956.

Daily and annual temperatures vary a great deal because of the elevation, the low humidity, and the continental location. A daily temperature range of 30° to 35° is common, but a range of 40° or more occurs occasionally. The mean monthly temperature at Goodland is 28.7° in January and 76.5° in July. Temperature extremes have ranged from −26° to 111°. About 58 days per year have a maximum temperature of 90° or higher, and an average of 8 days per year have a minimum of 0° or below.

The probabilities of the last freeze in spring and the first freeze in fall are given for five thresholds in table 10. The average freeze-free period is about 5 months, and it extends from early in May to early in October (*3*). At Goodland, the latest date in spring of a temperature of 32° or below was June 2, 1951. The earliest date of a 32° temperature in fall was September 20, 1912.

Sherman County is in the heaviest snowfall area in Kansas. The annual snowfall at Goodland averages 32 inches; most occur during the period December through March. The water equivalent of snow in winter and early in spring is light, but the moisture obtained from snow is important in the production of winter wheat. The heaviest snowfall usually occurs early in spring. An occasional blizzard occurs in winter, but is ordinarily of short duration.

Winds are moderate to occasionally strong in all seasons. The windiest period is March and April, when the average windspeed exceeds 14 miles per hour. The pre-

[5] By MERLE J. BROWN, State climatologist, National Weather Service, Manhattan, Kans.

TABLE 9.—*Temperature and precipitation*

[Data from Goodland]

Month	Temperature: Average daily maximum [1]	Temperature: Average daily minimum [1]	Temperature: Two years in 10 will have about 4 days with— Maximum temperature equal to or higher than [2]	Temperature: Two years in 10 will have about 4 days with— Minimum temperature equal to or lower than [2]	Precipitation: Average total [1]	Precipitation: One year in 10 will have— [3] Less than—	Precipitation: One year in 10 will have— [3] More than—	Precipitation: Days with snow cover of 1 inch or more [4]	Precipitation: Average depth of snow on days with snow cover [4]
	°F.	°F.	°F.	°F.	In.	In.	In.	No.	In.
January	41.6	15.7	61	−5	0.35	0.02	0.69	8	2
February	45.9	19.1	66	0	.49	.06	1.39	6	2
March	52.0	24.3	74	5	1.06	.16	2.20	6	4
April	64.0	35.2	82	21	1.67	.34	3.36	1	3
May	73.1	45.5	88	34	2.60	.85	4.44	(5)	3
June	84.3	55.5	100	44	2.84	1.03	5.54	------------	
July	91.6	61.4	102	54	2.64	.91	4.96	------------	
August	89.9	60.1	101	52	2.38	.56	4.34	------------	
September	81.5	50.4	96	38	1.27	.26	3.09	------------	
October	69.0	38.6	86	27	.98	.04	2.96	(5)	3
November	53.2	25.4	72	8	.57	.04	1.54	3	2
December	43.8	18.5	64	3	.45	.05	1.32	7	2
Year	65.8	37.5	[6] 104	[7] −12	17.30	11.06	25.62	32	3

[1] Period 1921–60.
[2] Period 1936–60.
[3] Period 1907–66.
[4] Period 1942–66.
[5] Less than 0.5 day.
[6] Average annual maximum, 1907–66.
[7] Average annual minimum, 1907–66.

vailing wind is southerly during the period April through October and is westerly-southwesterly or north-northwesterly in other months.

Clear to partly cloudy skies and abundant sunshine are the rule in Sherman County. The mean annual percentage of possible sunshine is about 70 percent. The number of cloudy days averages only 97 per year.

Farming

Grain and livestock are the main sources of income in Sherman County. Farming operations are on a large scale and are highly mechanized. According to the U.S. Census of Agriculture, there were 557 farms in the county in 1959. The average size was 1,136 acres. The number of farms had decreased to 517 in 1964, but the average size of farm had increased to 1,238.2 acres. Irrigation is rapidly increasing in this county. In 1954 there were 12 farms irrigating 934 acres; in 1959 there were 64 farms irrigating 9,646 acres; and in 1967 there were about 200 farms irrigating about 60,000 acres; the water was supplied by 320 wells.

Dryland crops in Sherman County are usually grown in a cropping sequence that includes summer fallow. During the fallow period, weeds are controlled to conserve moisture for the following crop. Wheat is the main crop in Sherman County, and the acreage has remained relatively stable although there is some variation from year to year. Sorghum is the second largest crop in the county, and the acreage of grain sorghum has shown a slow upward trend. Dryland alfalfa is grown for hay on some bottom land along streams.

Fallow is not used on irrigated soils. Wheat, sorghum, alfalfa, corn, and sugar beets are the main irrigated crops. Truck crops can be grown under irrigation, but marketing is a problem.

According to the biennial report of the Kansas State Board of Agriculture, crops harvested in 1965 were wheat from 147,000 acres, sorghum for grain and seed from 22,000 acres, sorghum for feed and forage from 13,200 acres, corn for grain from 12,200 acres, corn for silage from 2,400 acres, all hay from 8,600 acres, and sugar beets from 3,350 acres.

Beef cattle are the principal kind of livestock in Sherman County. The number varies from year to year, depending on the supply of feed. In addition to the cattle raised locally, many animals are brought into the county to graze on winter wheat pasture and sorghum stubble. Sheep and lambs are the second most important kinds of livestock, and swine are the third. The number of cattle in feedlots is increasing because of the recent increase in the acreage of irrigated feed crops.

In 1965, according to the biennial report of the Kansas State Board of Agriculture, there were 24,000 cattle, 11,600 sheep and lambs, 5,100 swine, and 9,000 chickens over 3 months old. The number of chickens has decreased through the years. The number of cattle, sheep, and swine has remained about the same or has increased slightly.

Water Supply

In most areas of Sherman County water is obtained from wells drilled into the ground water. The depth to the water table ranges from less than 10 feet in some stream

TABLE 10.—*Probability of last freezing temperature in spring and first in fall*

[Data from central Sherman County]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	April 14	April 18	April 22	May 7	May 22
2 years in 10 later than	April 8	April 12	April 17	May 2	May 17
5 years in 10 later than	March 26	April 2	April 8	April 22	May 7
Fall:					
1 year in 10 earlier than	October 25	October 20	October 13	October 3	September 23
2 years in 10 earlier than	October 31	October 25	October 17	October 8	September 27
5 years in 10 earlier than	November 12	November 5	October 27	October 17	October 7

valleys to more than 200 feet on uplands, and it is more than 100 feet in most places. The Ogallala Formation is the main water-bearing formation, and most wells in the uplands are drilled into this formation. Some wells are drilled into the alluvial deposits along Beaver Creek and the North Fork of the Smoky Hill River.

Yields from irrigation wells range from less than 500 to more than 2,000 gallons per minute, but average about 900 gallons per minute. Water from both the Ogallala Formation and the alluvium is moderately hard, but the quality is suitable for most purposes.

Industry

Most of the industries in Sherman County supply needed services and material for farming. The manufacturing industries are plants that process livestock feeds and that manufacture beet sugar and vacuum cleaners. A plant at Edson processes the diatomaceous marl that is mined in Wallace County. Some sand and gravel are mined, mostly for use in surfacing roads.

Transportation and Markets

A large part of the farm products is shipped out of the county by truck or by rail. Interstate Highway No. 70 and U.S. Highway No. 24 cross the county from west to east, and State Route 27 crosses from north to south. This county is served by a railroad line that crosses the county from east to west. All of the towns in the county are along this railroad and U.S. Highway No. 24. Goodland is at the intersection of U.S. Highway No. 24 and State Route 27. Scheduled airline flights are also available each day from Goodland.

Marketing facilities for grain are in each town. A livestock auction is held once a week in Goodland. Most of the livestock is shipped to markets in Denver, Colo.

Community Facilities

There are five elementary schools in Sherman County; three are in Goodland. Also in Goodland are a junior high school, a high school, and a vocational technical school. A high school is in Edson. There are 18 churches in the county; 16 of them are in Goodland. A large hospital and rehabilitation center and a new medical arts clinic are also in Goodland. A State lake is in the area of the North Fork of the Smoky Hill River. This lake and the surrounding area help meet the need for recreation facilities.

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil, or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before planting cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residue, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residue.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizons. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leached soil. A soil from which most of the soluble materials have been removed from the entire profile or have been removed from one part of the profile and have accumulated in another part.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow*, *slow*, *moderately slow*, *moderate*, *moderately rapid*, *rapid*, and *very rapid*.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sands grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthly parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided be specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. An explanation of the capability classification begins on page 18. For complete information about a capability unit, read both the introductions to "Management of Dryland Soils" and "Management of Irrigated Soils" and the descriptions of the capability units in those sections. For information about the suitability of soils for windbreaks and as wildlife habitat, read the introduction to these sections and refer to the tables in each section. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields of dryland crops, table 2, page 21.
Predicted yields of irrigated crops, table 3, page 24.
Use of the soils in engineering, tables 6 and 7, pages 32 through 39.

Map symbol	Mapping unit	Page	Capability unit				Range site		Windbreak group
			Dryland	Page	Irrigated	Page	Name	Page	
Ad	Alluvial land--------------------	6	VIw-1	21	--------	--	Loamy Lowland	26	Lowland
Bd	Bridgeport silt loam, 0 to 2 percent slopes-----------------	7	IIc-2	20	I-2	23	Loamy Terrace	26	Upland
Be	Bridgeport silt loam, 2 to 4 percent slopes-----------------	7	IIIe-1	20	IIe-1	23	Loamy Terrace	26	Upland
Bs	Bridgeport-Slickspots complex----	7	IVs-1	20	IVs-1	23	Loamy Terrace	26	-------
Ca	Caruso loam----------------------	9	IIIw-1	20	IIw-1	23	Saline Subirrigated	27	Lowland
Cb	Colby silt loam, 6 to 15 percent slopes------------------------	9	VIe-1	21	--------	--	Limy Upland	26	Upland
Cu	Colby-Ulysses silt loams, 3 to 6 percent slopes, eroded-------	10	IVe-1	20	IIIe-1	23	Limy Upland	26	Upland
Go	Goshen silt loam-----------------	11	IIc-2	20	I-2	23	Loamy Terrace	26	Lowland
Ke	Keith silt loam, 0 to 1 percent slopes------------------------	12	IIc-1	19	I-1	22	Loamy Upland	25	Upland
Kh	Keith silt loam, 1 to 3 percent slopes------------------------	12	IIe-1	19	IIe-1	23	Loamy Upland	25	Upland
Ku	Keith-Ulysses silt loams, 0 to 1 percent slopes---------------	13	IIc-1	19	I-1	22	Loamy Upland	25	Upland
Pe	Pleasant silty clay loam---------	14	IVw-1	20	IVw-1	23	Clay Upland	26	-------
Rc	Richfield silt loam, 0 to 1 percent slopes-----------------	14	IIc-1	19	I-1	22	Loamy Upland	25	Upland
Rh	Rough broken and gravelly land---	15	VIe-2	21	--------	--	-------------	--	-------
	Moderately deep to deep, loamy soils----------------	--	------	--	--------	--	Limy Upland	26	-------
	Coarse-textured, gravelly soils---------------------	--	------	--	--------	--	Sandy	26	-------
	Shallow, loamy soils---------	--	------	--	--------	--	Shallow Limy	27	-------
Ro	Roxbury silt loam----------------	16	IIc-2	20	I-2	23	Loamy Terrace	26	Upland
Rx	Roxbury silt loam, frequently flooded-----------------------	16	IIIw-2	20	IIw-2	23	Loamy Lowland	26	Lowland
Ua	Ulysses silt loam, 1 to 3 percent slopes-----------------	17	IIIe-1	20	IIe-1	23	Loamy Upland	25	Upland
Ub	Ulysses silt loam, 3 to 6 percent slopes-----------------	17	IVe-1	20	IIIe-1	23	Loamy Upland	25	Upland
Uc	Ulysses silt loam, 6 to 10 percent slopes-----------------	18	VIe-1	21	--------	--	Loamy Upland	25	Upland
Ud	Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded-------	18	IIIe-1	20	IIe-1	23	Limy Upland	26	Upland
Uk	Ulysses-Keith silt loams, 0 to 1 percent slopes---------------	18	IIc-1	19	I-1	22	Loamy Upland	25	Upland
Wa	Wet alluvial land----------------	18	Vw-1	21	--------	--	Wet Land	27	-------

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program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

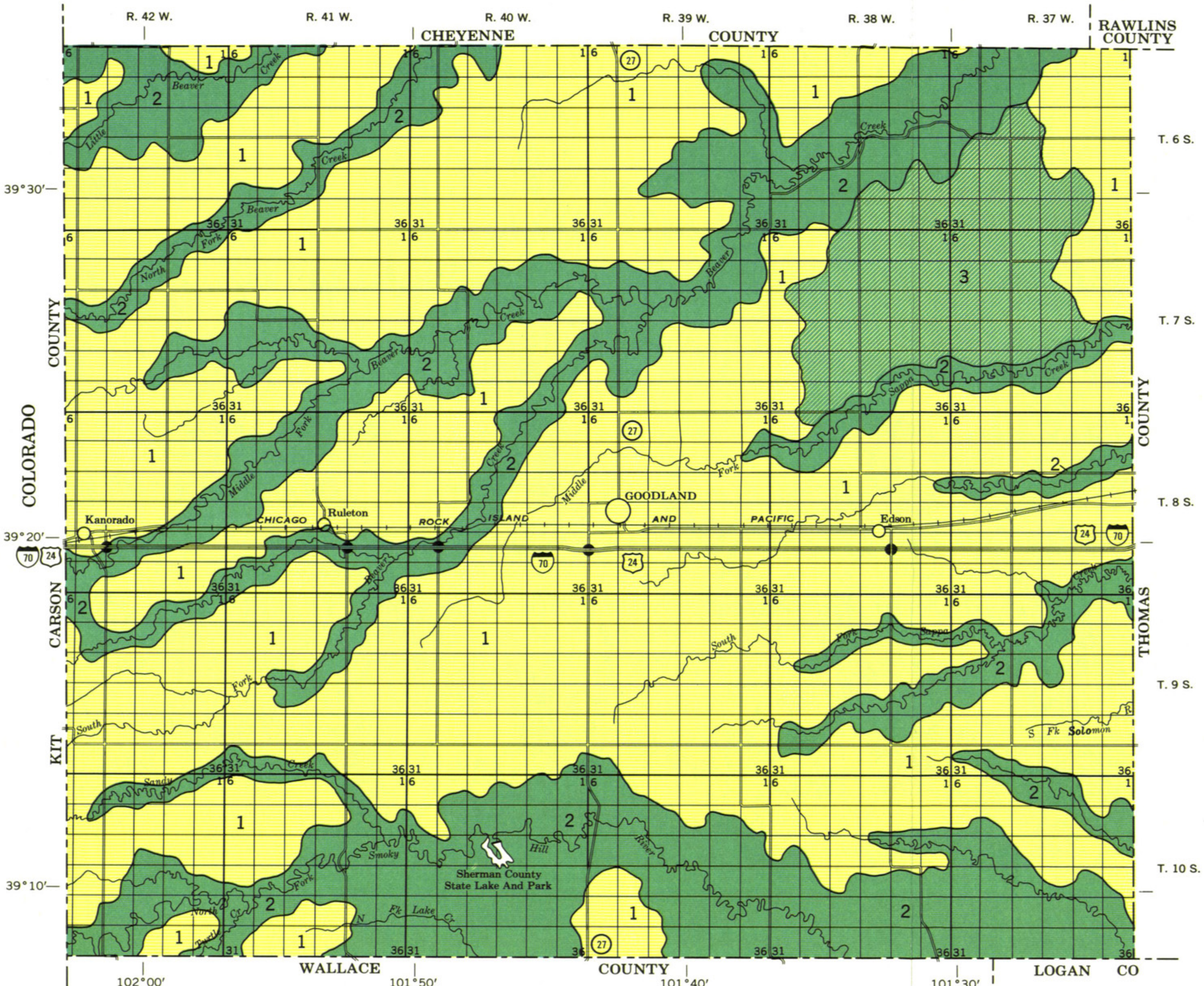
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

SHERMAN COUNTY, KANSAS

Scale 1 : 253 440

1 0 1 2 3 4 Miles



SOIL ASSOCIATIONS*

1	Keith-Ulysses association: Deep, well-drained, nearly level and gently sloping silt loams on uplands
2	Ulysses-Colby-Goshen association: Deep, well-drained, nearly level to strongly sloping silt loams on uplands, terraces, and flood plains
3	Keith-Ulysses-Goshen association: Deep, well-drained, nearly level to sloping silt loams on uplands and in swales

* The texture given is that of the surface layer of the major soils in the associations.

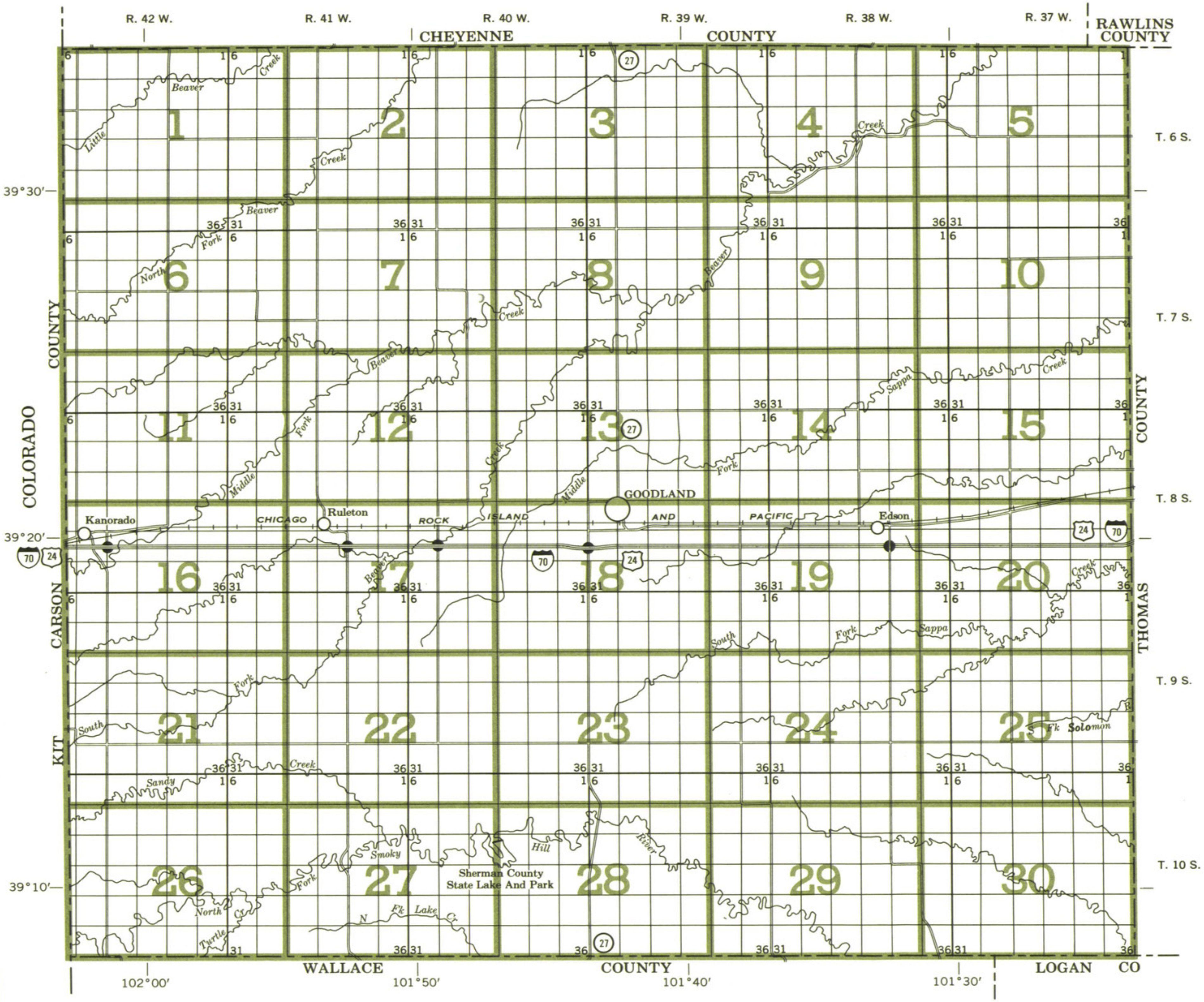
Published 1972

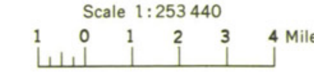
This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning.

INDEX TO MAP SHEETS

SHERMAN COUNTY, KANSAS

Scale 1:253 440





SOIL LEGEND

SYMBOL	NAME
Ad	Alluvial land
Bd	Bridgeport silt loam, 0 to 2 percent slopes
Be	Bridgeport silt loam, 2 to 4 percent slopes
Bs	Bridgeport-Slickspots complex
Ca	Caruso loam
Cb	Colby silt loam, 6 to 15 percent slopes
Cu	Colby-Ulysses silt loams, 3 to 6 percent slopes, eroded
Go	Goshen silt loam
Ke	Keith silt loam, 0 to 1 percent slopes
Kh	Keith silt loam, 1 to 3 percent slopes
Ku	Keith-Ulysses silt loams, 0 to 1 percent slopes
Pe	Pleasant silty clay loam
Rc	Richfield silt loam, 0 to 1 percent slopes
Rh	Rough broken and gravelly land
Ro	Roxbury silt loam
Rx	Roxbury silt loam, frequently flooded
Ua	Ulysses silt loam, 1 to 3 percent slopes
Ub	Ulysses silt loam, 3 to 6 percent slopes
Uc	Ulysses silt loam, 6 to 10 percent slopes
Ud	Ulysses-Colby silt loams, 1 to 3 percent slopes, eroded
Uk	Ulysses-Keith silt loams, 0 to 1 percent slopes
Wa	Wet alluvial land

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

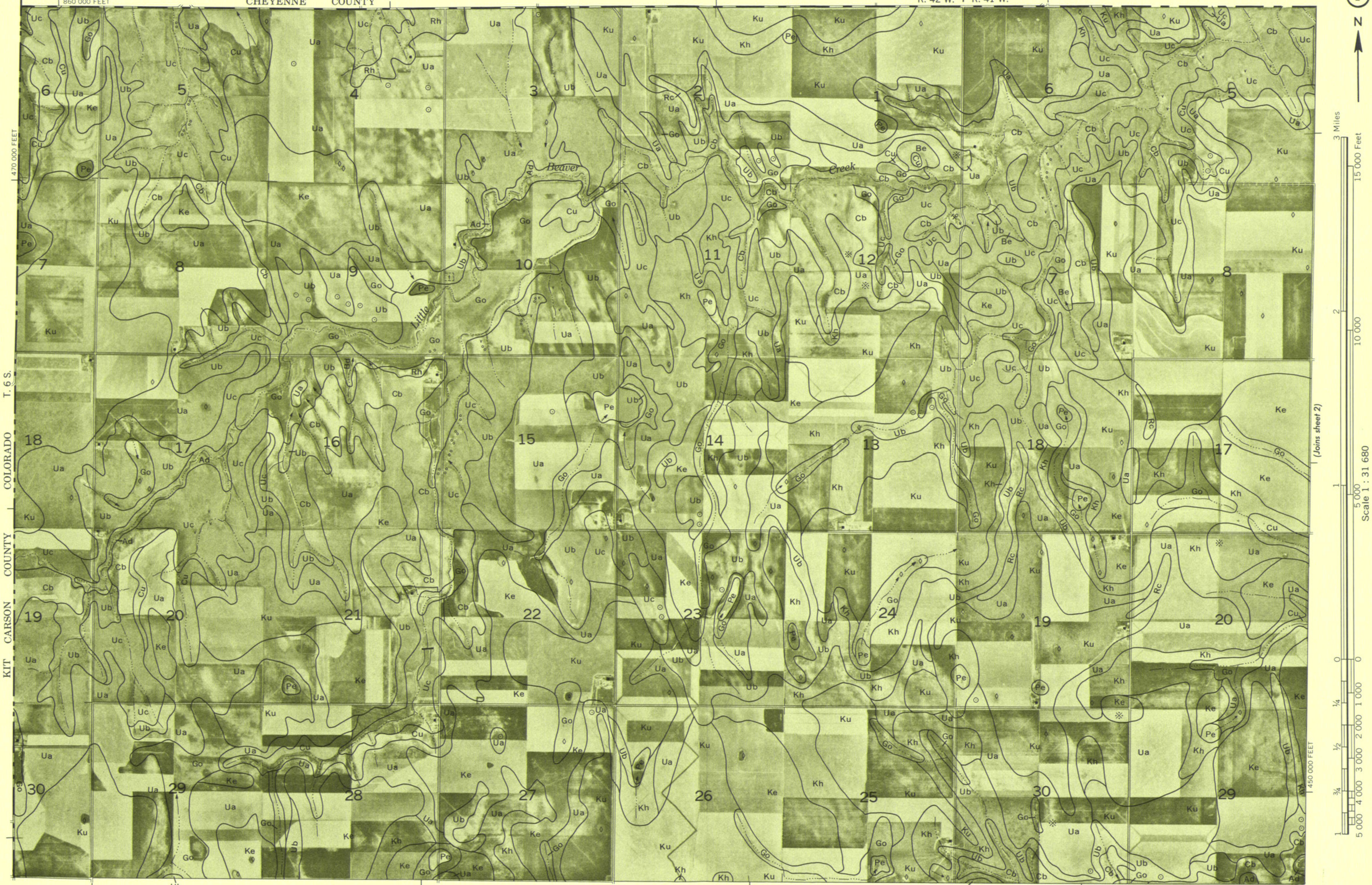
Escarpments
- Bedrock
- Other

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness: Stony; Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Limy spot



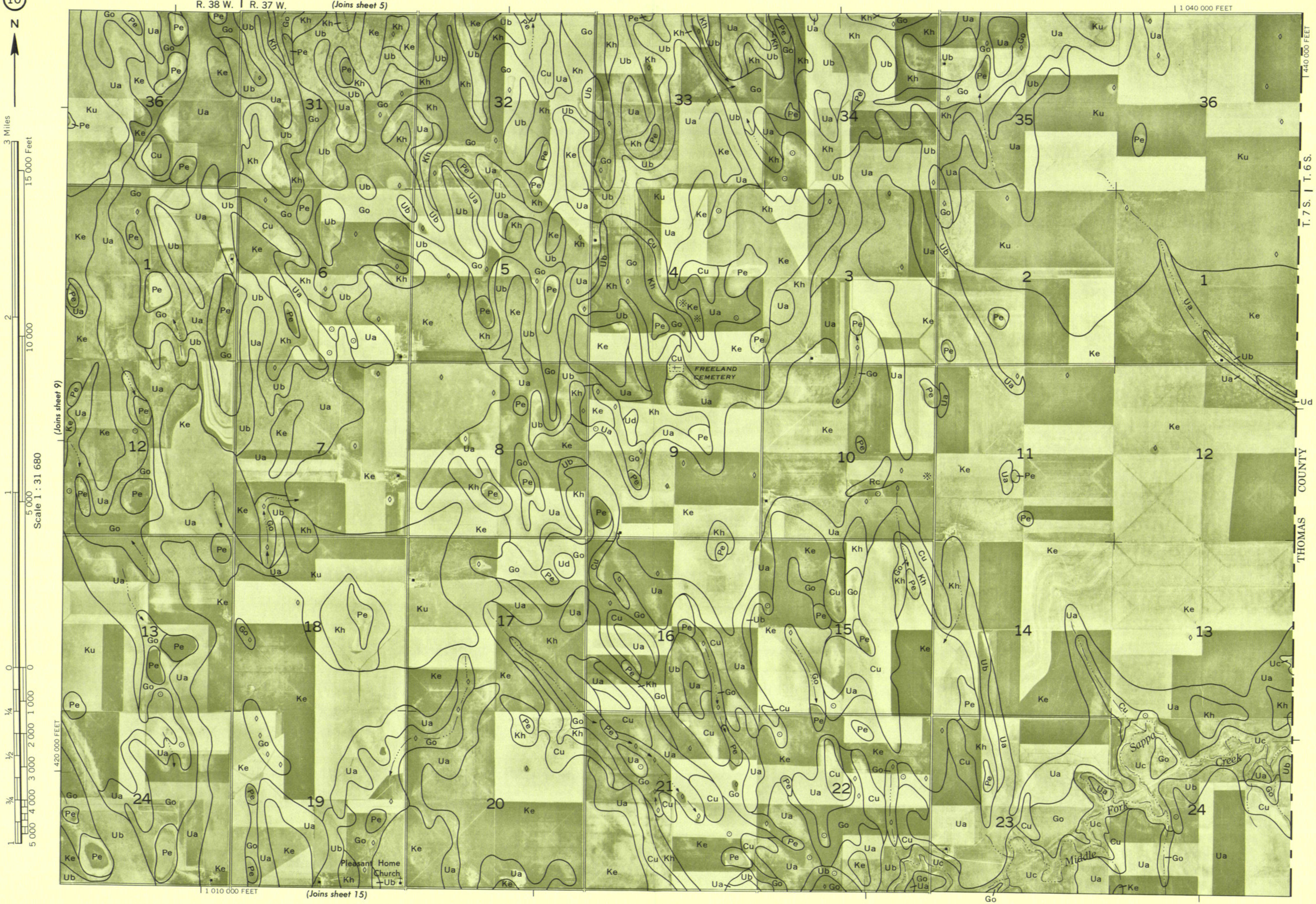
SHERMAN COUNTY, KANSAS NO. 1

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

Land division corners are positioned on this map.

SHERMAN COUNTY, KANSAS — SHEET NUMBER 10



SHERMAN COUNTY, KANSAS NO. 10

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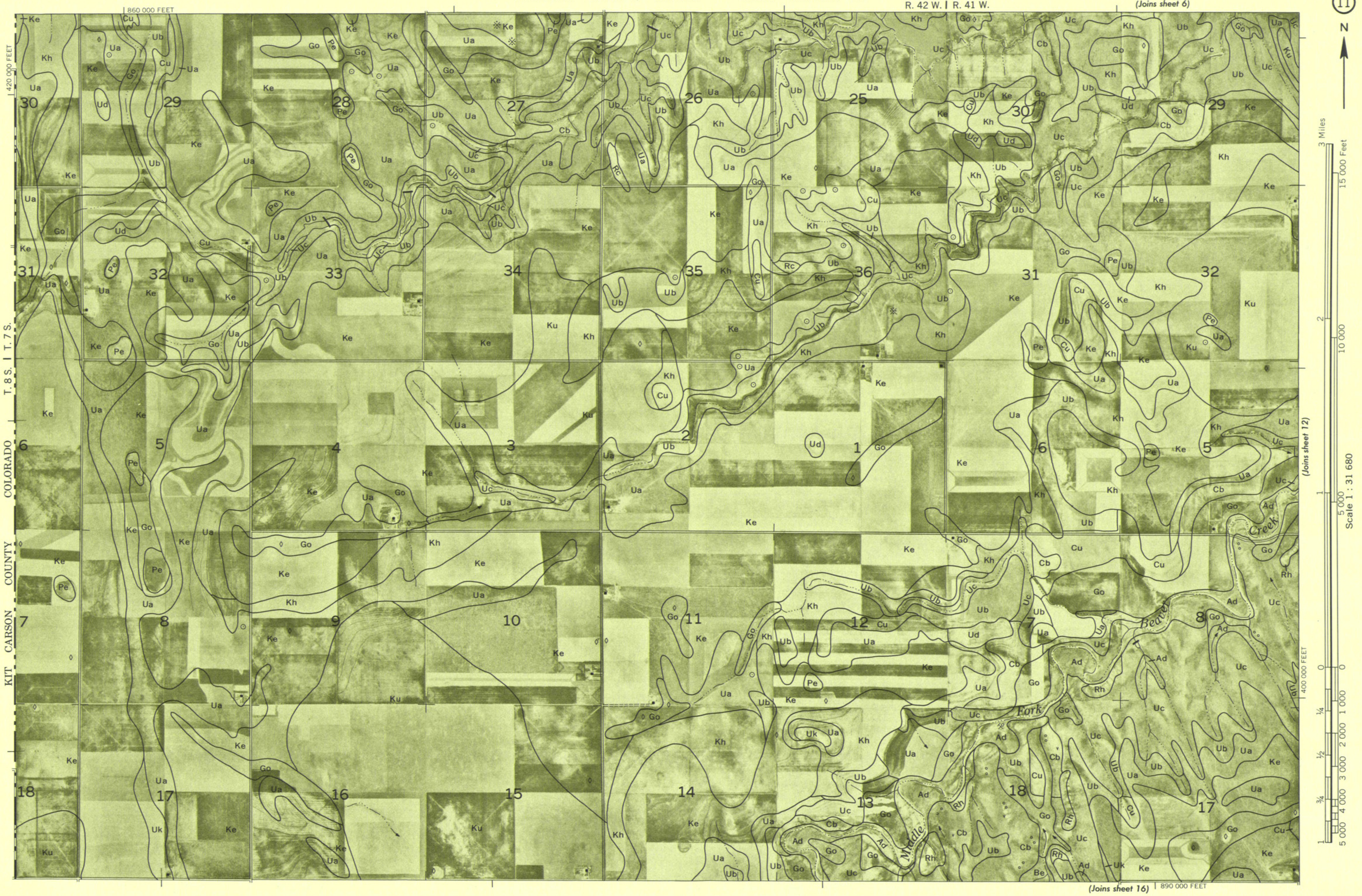
SHERMAN COUNTY, KANSAS — SHEET NUMBER 11



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SHERMAN COUNTY, KANSAS NO. 11

SHERMAN COUNTY, KANSAS NO. 12

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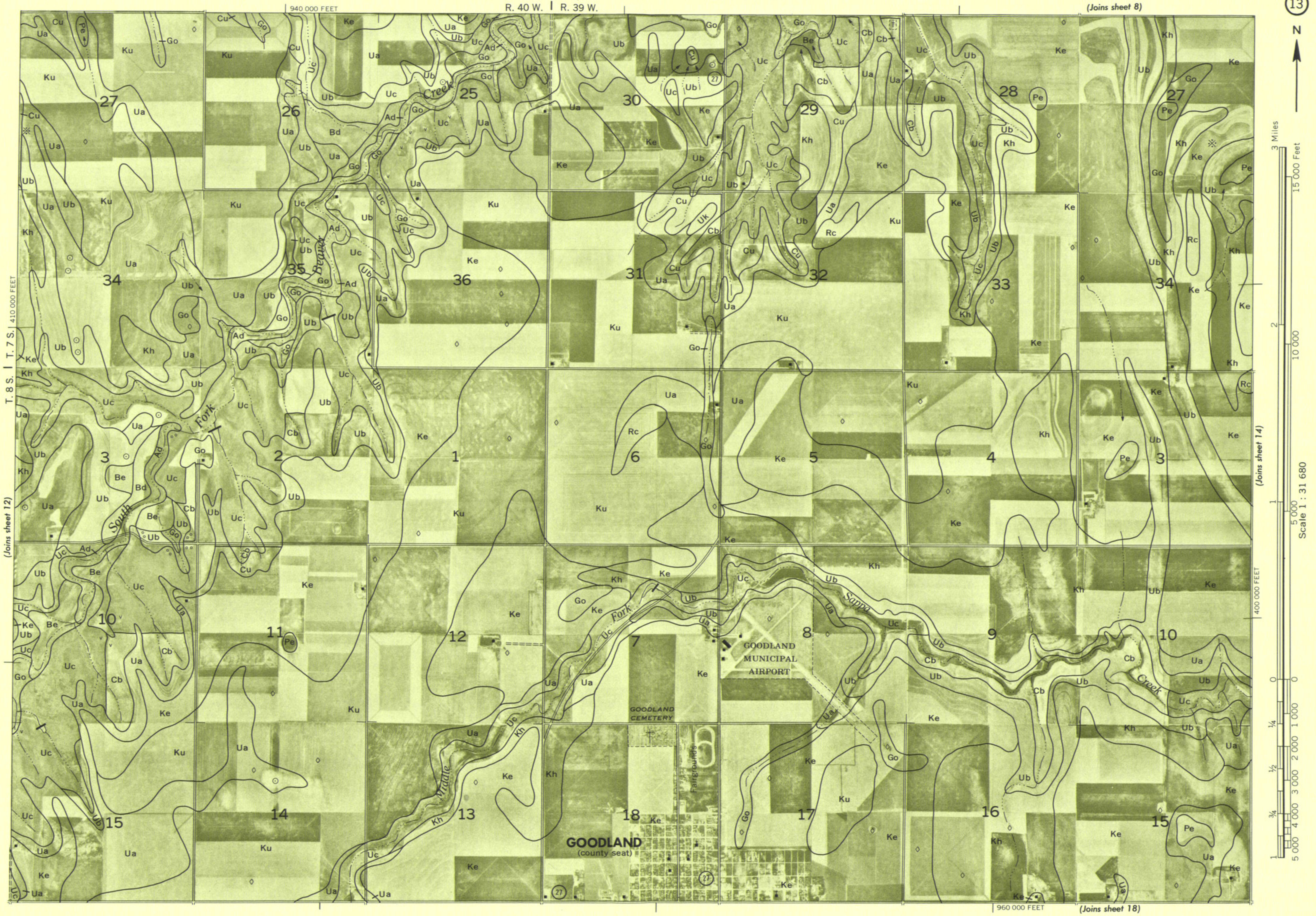

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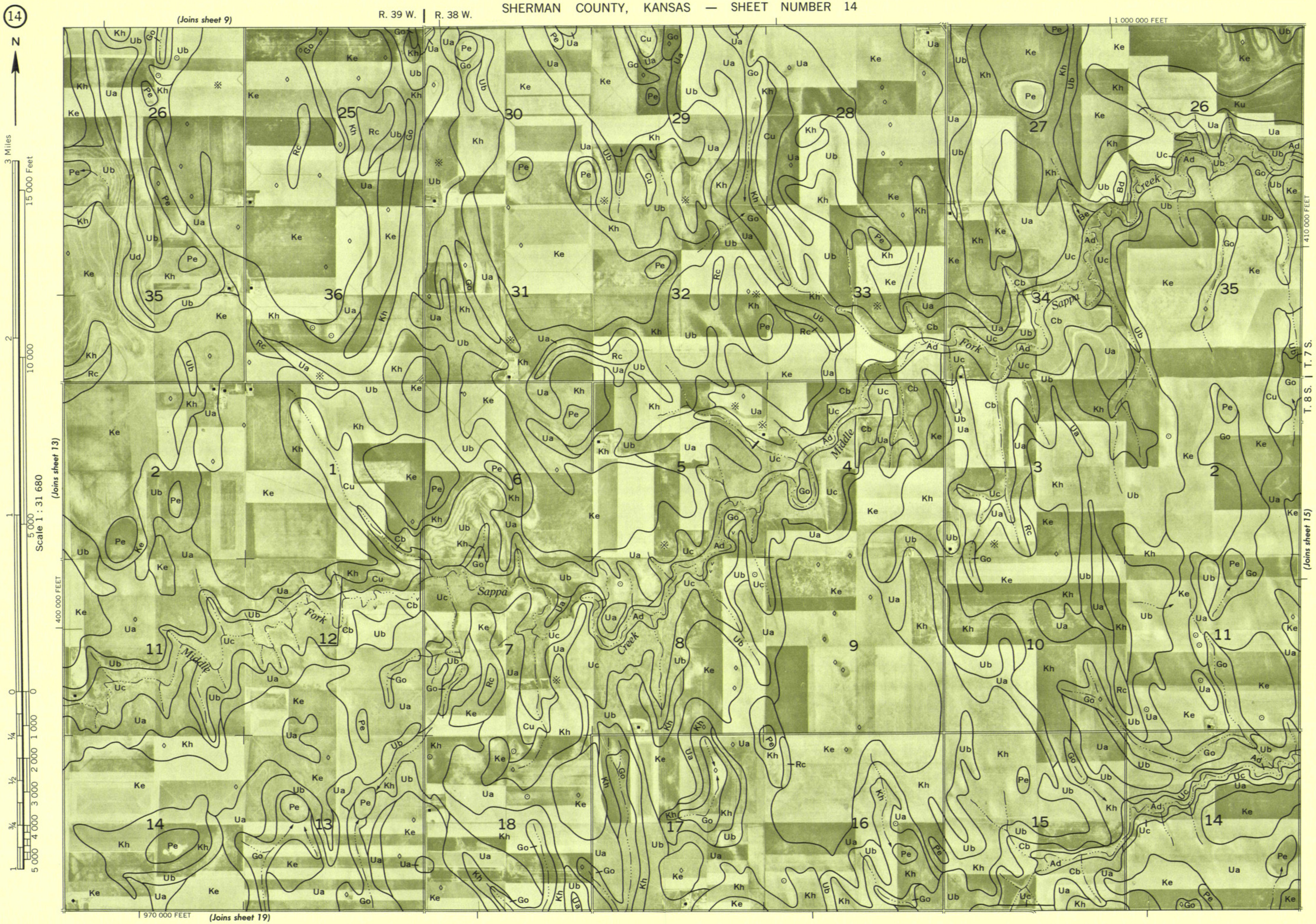
SHERMAN COUNTY, KANSAS NO. 13

SHERMAN COUNTY, KANSAS — SHEET NUMBER 14



SHERMAN COUNTY, KANSAS NO. 14

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SHERMAN COUNTY, KANSAS — SHEET NUMBER 15

(15)

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SHERMAN COUNTY, KANSAS NO. 15

SHERMAN COUNTY, KANSAS — SHEET NUMBER 16

SHERMAN COUNTY, KANSAS NO. 16

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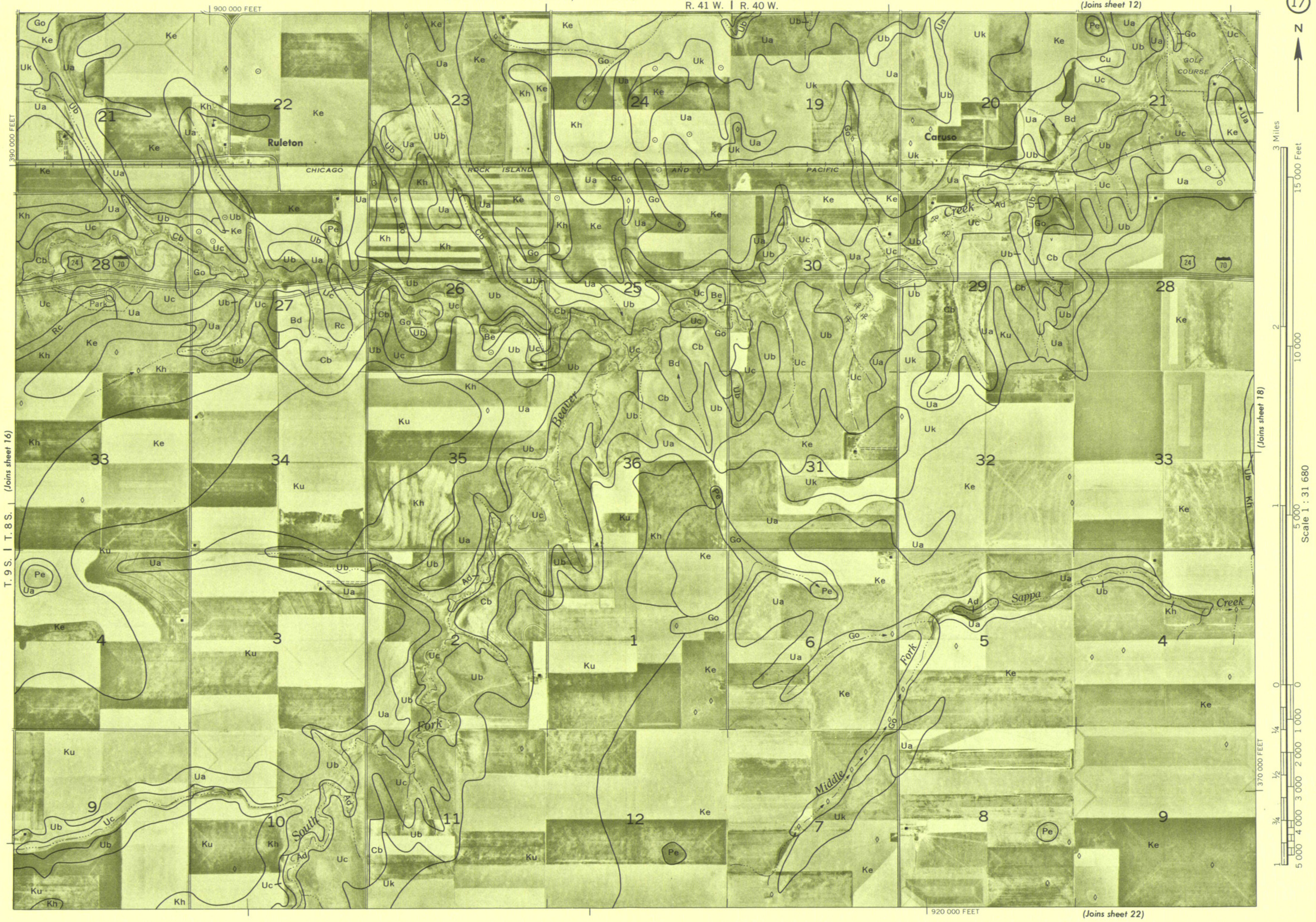
SHERMAN COUNTY, KANSAS — SHEET NUMBER 17

(17)



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Land division corners are approximately positioned on this map.

SHERMAN COUNTY, KANSAS NO. 17

SHERMAN COUNTY, KANSAS — SHEET NUMBER 18

(18)

N

Scale 1 : 31 680

3 Miles
15 000 Feet

SHERMAN COUNTY, KANSAS NO. 18

Land division corners are approximately positioned on this map.

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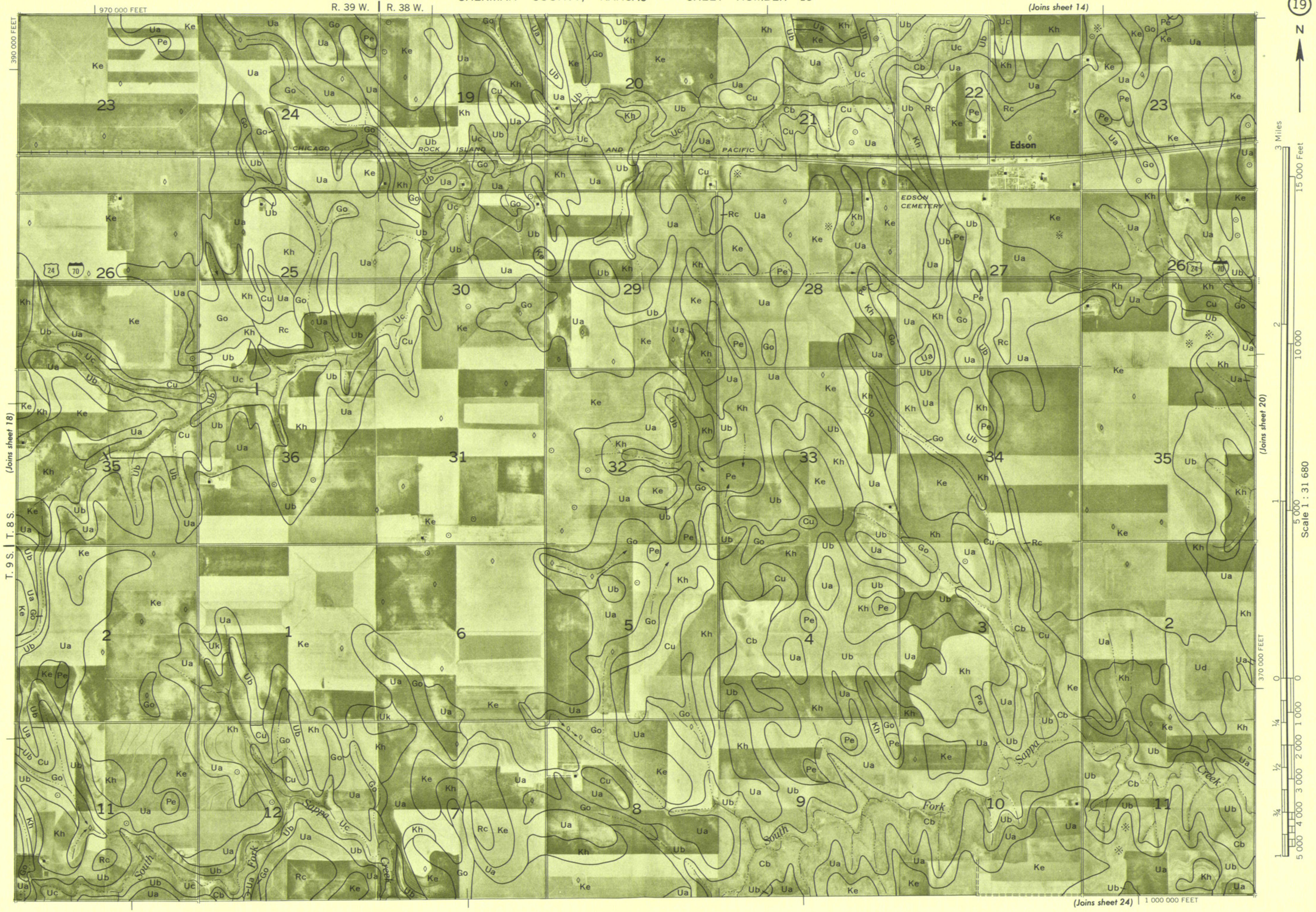

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Land division corners are approximately positioned on this map.

SHERMAN COUNTY, KANSAS NO. 19

SHERMAN COUNTY, KANSAS — SHEET NUMBER 2

SHERMAN COUNTY, KANSAS NO. 2

Land division corners are approximately positioned on this map.

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SHERMAN COUNTY, KANSAS — SHEET NUMBER 20

SHERMAN COUNTY, KANSAS NO. 20

Land division corners are approximately positioned on this map.

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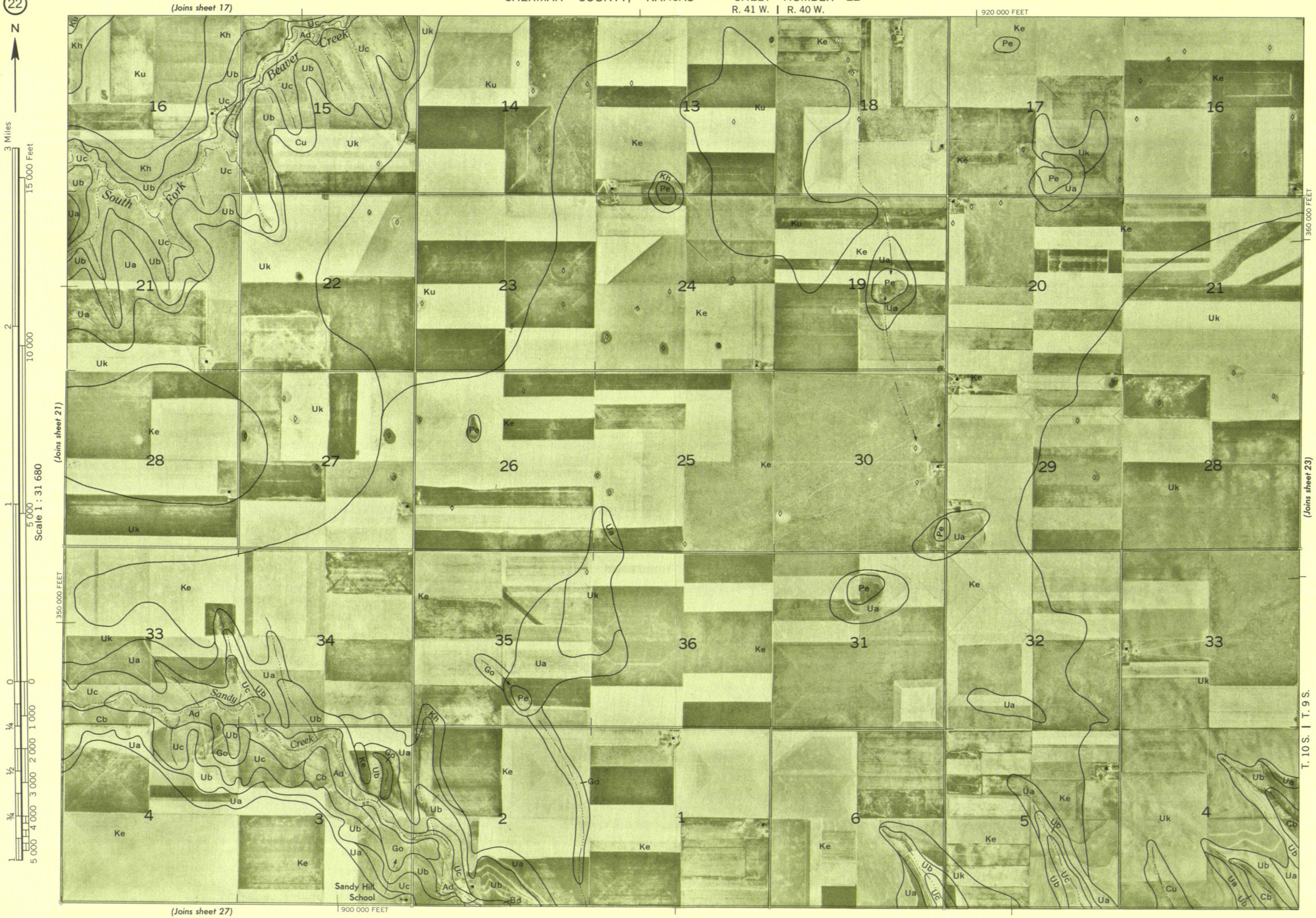
Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.
Land division corners are approximately positioned on this map.
SHERMAN COUNTY, KANSAS NO. 21

SHERMAN COUNTY, KANSAS — SHEET NUMBER 22



SHERMAN COUNTY, KANSAS NO. 22

Land division corners are approximately positioned on this map.

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SHERMAN COUNTY, KANSAS — SHEET NUMBER 23

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Land division corners are approximately positioned on this map.

SHERMAN COUNTY, KANSAS NO. 23

SHERMAN COUNTY, KANSAS — SHEET NUMBER 24

N

Scale 1 : 31 680

3 Miles
2
1
0
15 000 Feet
10 000
5 000
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1

SHERMAN COUNTY, KANSAS NO. 24

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.

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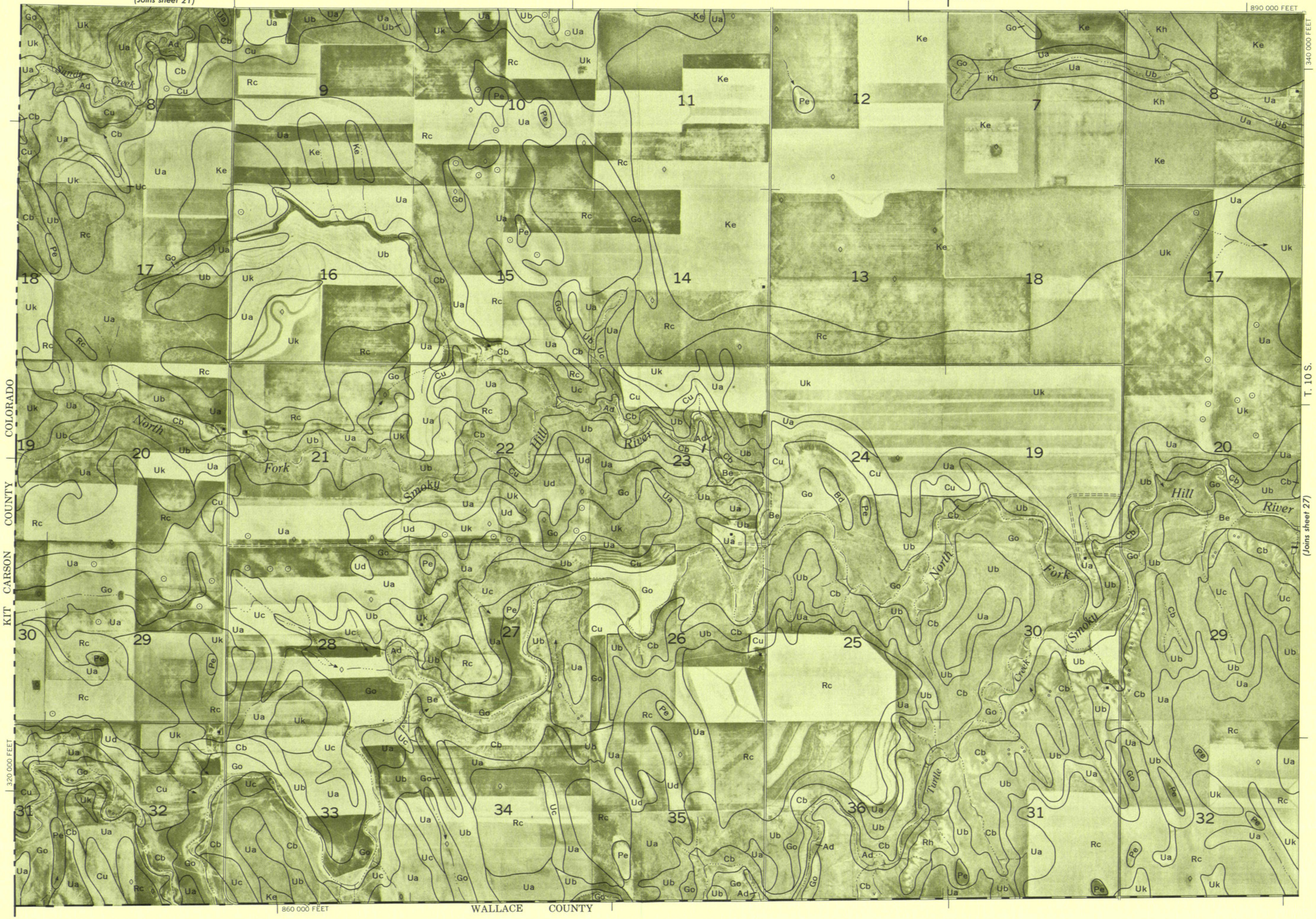
Land division corners are approximately positioned on this map.

SHERMAN COUNTY, KANSAS NO. 25

SHERMAN COUNTY, KANSAS — SHEET NUMBER 26



N

Scale 1 : 31 680

3 Miles
2
1
0
¼
½
¾
1

15 000 Feet
10 000
5 000
0
1 000
2 000
3 000
4 000
5 000

SHERMAN COUNTY, KANSAS NO. 26

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

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Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.
Land division corners are approximately positioned on this map.
SHERMAN COUNTY, KANSAS NO. 27

SHERMAN COUNTY, KANSAS — SHEET NUMBER 28

SHERMAN COUNTY, KANSAS NO. 28

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.

SHERMAN COUNTY, KANSAS — SHEET NUMBER 29

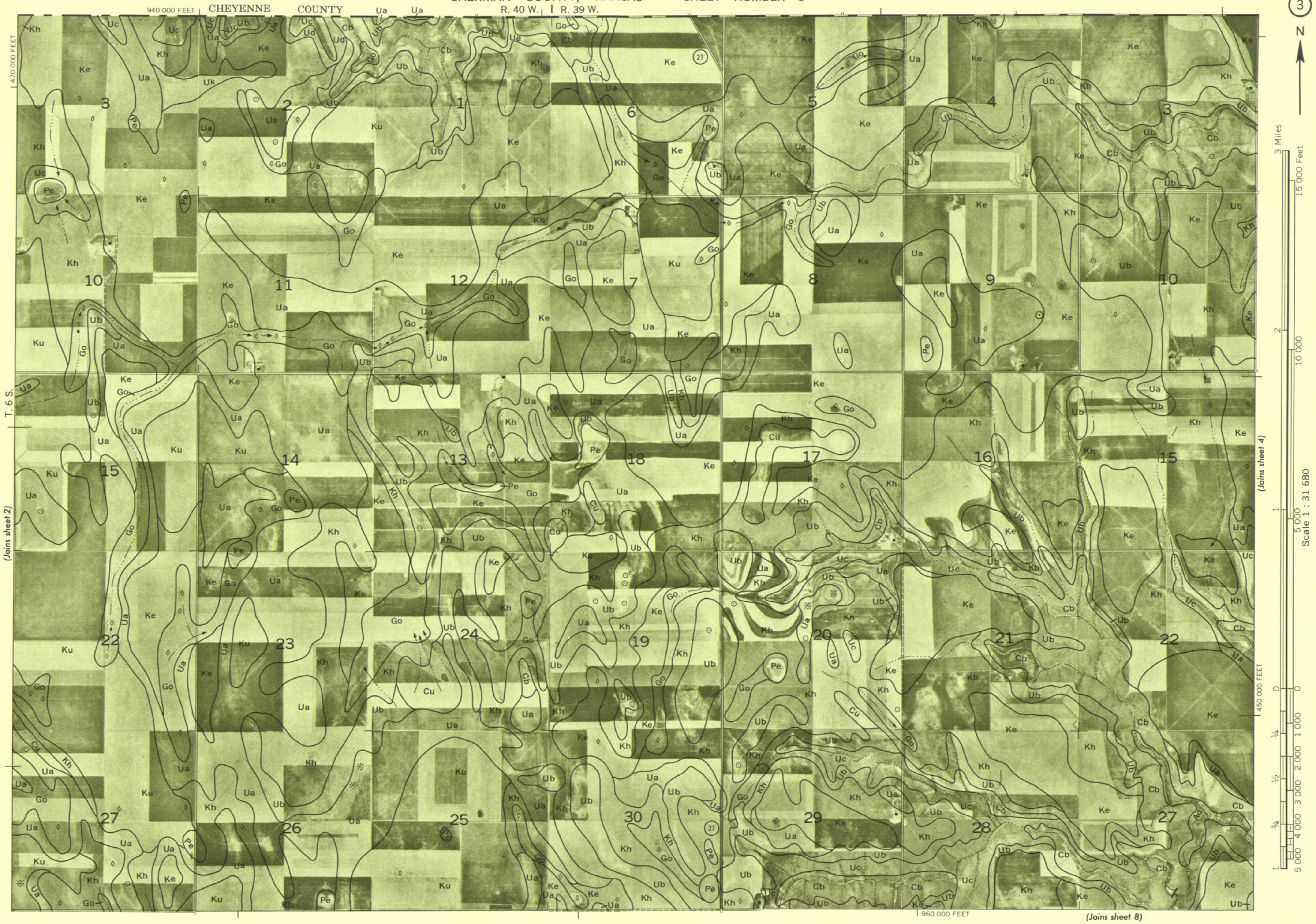
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station. Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

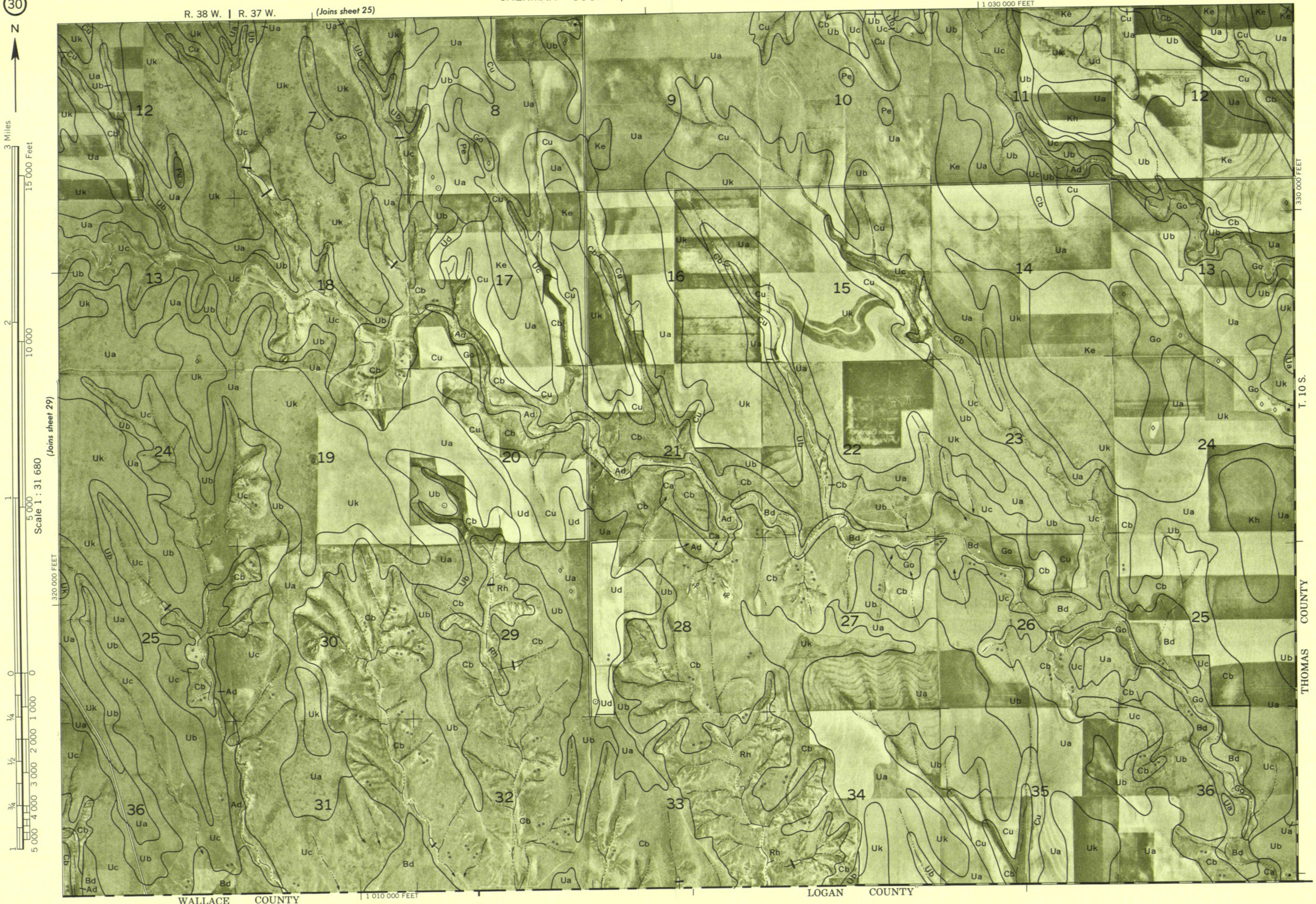
SHERMAN COUNTY, KANSAS NO. 29

SHERMAN COUNTY, KANSAS — SHEET NUMBER 3

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.
Land division corners are approximately positioned on this map.
SHERMAN COUNTY, KANSAS NO. 3



SHERMAN COUNTY, KANSAS — SHEET NUMBER 30



SHERMAN COUNTY, KANSAS NO. 30

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.

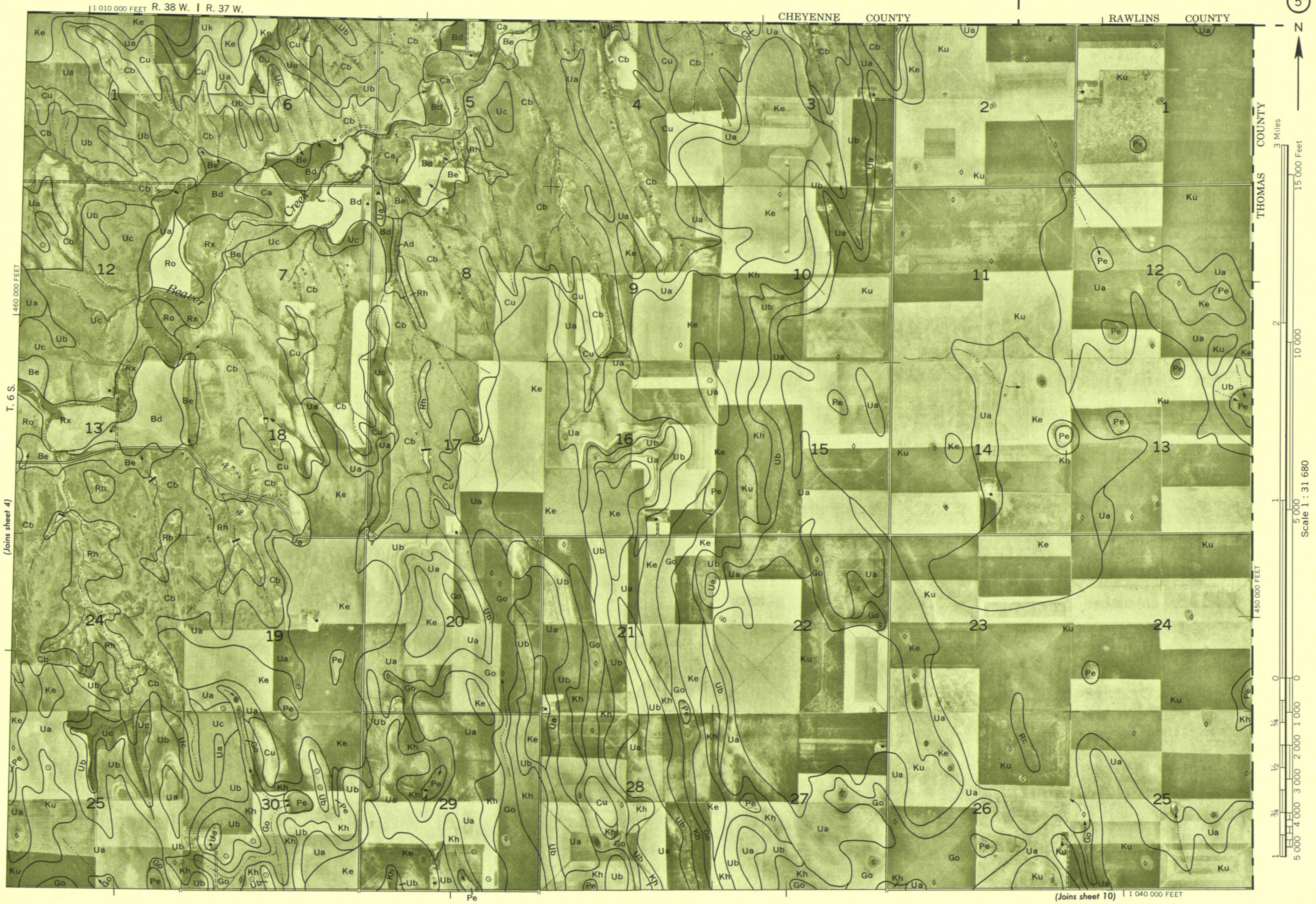
SHERMAN COUNTY, KANSAS — SHEET NUMBER 4

SHERMAN COUNTY, KANSAS NO. 4

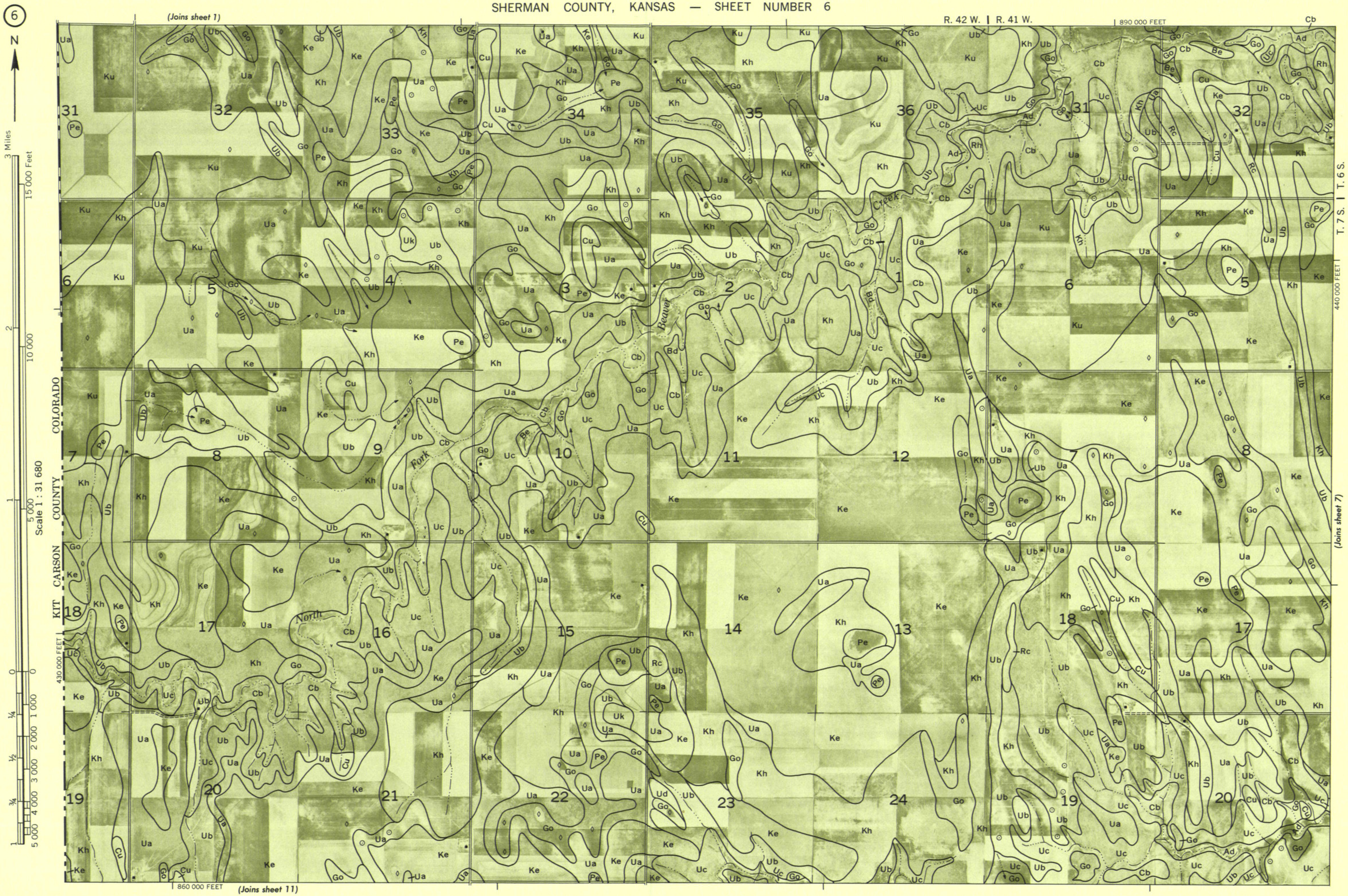
Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.
Land division corners are approximately positioned on this map.



SHERMAN COUNTY, KANSAS NO. 6

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.

SHERMAN COUNTY, KANSAS — SHEET NUMBER 7

7

N

R. 41 W. | R. 40 W.

900 000 FEET

(Joins sheet 2)

T. 6 S. | T. 7 S.

440 000 FEET

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 12)

930 000 FEET

420 000 FEET

3 Miles | 2 | 1 | 0 | 1

15 000 Feet | 10 000 | 5 000 | 0 | 1 000 | 2 000 | 3 000 | 4 000 | 5 000

Scale 1 : 31 680

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

Land division corners are approximately positioned on this map.

SHERMAN COUNTY, KANSAS NO. 7

SHERMAN COUNTY, KANSAS — SHEET NUMBER 8

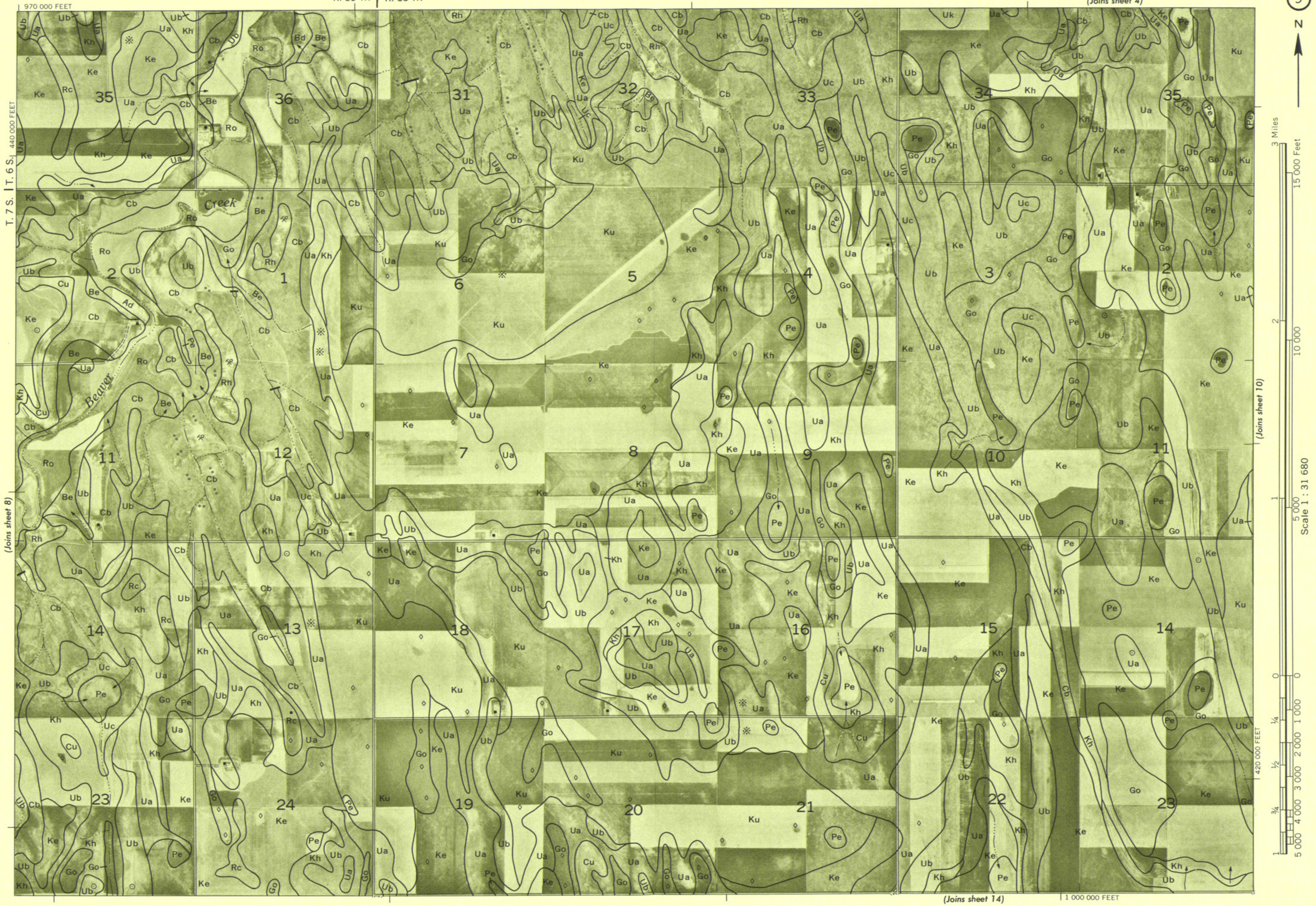
SHERMAN COUNTY, KANSAS NO. 8

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.

SHERMAN COUNTY, KANSAS — SHEET NUMBER 9



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Kansas Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 10,000-foot grid ticks based on Kansas plane coordinate system, north zone. 1927 North American datum.

Land division corners are approximately positioned on this map.

SHERMAN COUNTY, KANSAS NO. 9